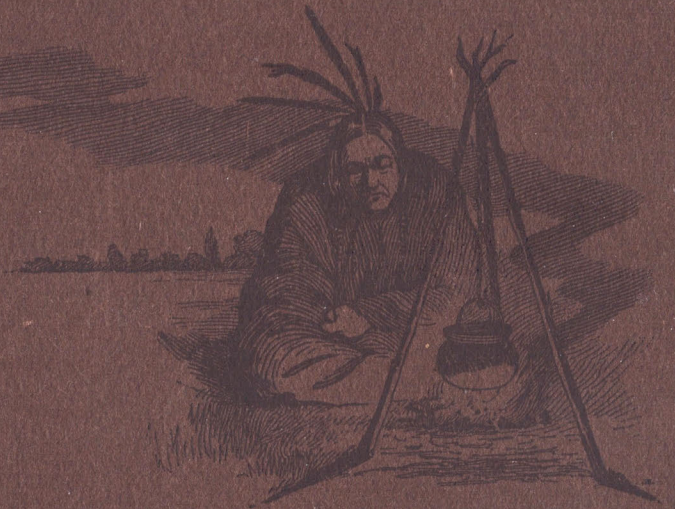
The Brownell & Company

DAYTON, OHIO. U.S.A.

STEAM BOILERS.



ESTABLISHED 1855
INCORPORATED 1888

THE BROWNELL & COMPANY,

ENGINEERS, FOUNDERS AND MACHINISTS.

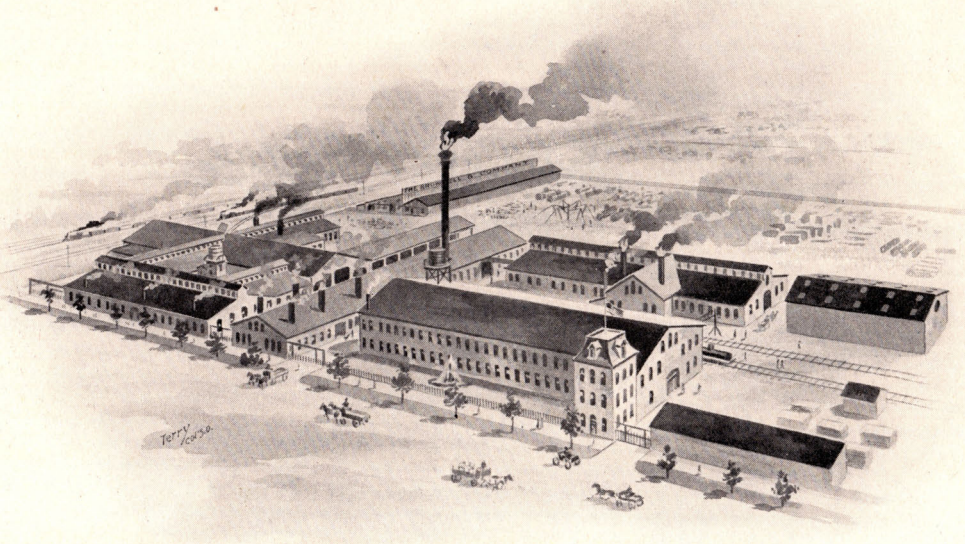
MANUFACTURERS OF

ENGINES, BOILERS,
FEED WATER HEATERS,
SAW MILLS AND SHEET IRON WORK.

DAYTON, OHIO, U. S. A.

CATALOGUE No. 48

THIS CATALOGUE SUPERSEDES ALL PREVIOUS ISSUES



INTRODUCTION.

IN presenting a new edition of our catalogue of Boilers, Heaters, Etc., we feel that a few words by way of explanation are advisable. Those who are familiar with the line of boilers built by us in years past will notice in the lines specified herein a number of changes, not only in the specifications, but also in the details of construction. These are changes which have been necessitated by changing conditions of the times, by improved methods of manufacture, and by a better knowledge of the correct design and proportion of the various parts of the steam boiler and its setting, as advocated by the best authorities on this subject and in accordance with the results of our own experience.

We have the largest and best equipped boiler shop in this section of the country. We can make prompt shipment of any standard boiler. Our material, workmanship and design are of the best, and we feel that this position must command the patronage of all who wish to procure boilers made from the best material and in the best manner.

We wish to take this opportunity to thank our friends and patrons for their custom in the past, and solicit a continuance of the same, pledging ourselves to maintain the high standard of excellence that has always characterized our product.

Yours truly,

THE BROWNELL & COMPANY.

DAYTON, OHIO.

General Specifications for Boilers.

That our customers and those who anticipate purchasing from us may know the details of construction, we submit the following specifications, viz.:

Material We used open hearth homogeneous flange steel, tensile strength 60,000, with an elastic limit of 30,000 pounds, an elongation of 20 per cent. in an 8-inch section, a reduction of area from 40 to 50 per cent., and it can be turned over and closed down solid when cold without fracture. The same can be done after heating and plunging into cold water. We are also prepared to contract for special makes of steel, when desired.

Proportion for Boilers The specifications of our Standard Boilers for thickness of material, number, size and length of tubes, are such that we can confidently recommend to our patrons, being the result of many years' practical experience, and advocated by the best authorities on the subject. In this connection we would add that we consider the practice of crowding a boiler with tubes a bad one. It weakens the heads, gives no space for man-holes, and takes up the most valuable steam generating space in a boiler, i. e., that immediately over the fire. A boiler so filled with tubes will figure up theoretically a horse-power that will not be fulfilled when put into use, as many of the lower tubes will be found almost useless in generating steam, because the heated gases will not go through them. It will be seen that in boilers of 44 inches and over our specifications call for 3½-inch tubes, and that we also list a line of 4-inch Horizontal Tubulars which we recommend particularly for boilers of large diameters and lengths.

Flanging All heads are flanged on a special machine of new and improved design, capable of flanging heads as large as 10 feet in diameter and as small as 14 inches. In connection with it we have an annealing furnace capable of heating the largest size boiler head uniformly throughout, and the plant is so arranged that the head goes to the Flanging Machine at the proper heat, and before it is allowed to cool the entire flange is turned. In flanging with this machine the knuckle or turn of the flange is made the thickest part. Owing to the entire head being heated to the same temperature there are no cracks, checks, or flaws in the flange; but it has a neat appearance, and is much better than can be done by hand, where frequent reheating is necessary, and the head is allowed to cool while flanging. Owing to the peculiar construction of this machine, no hole is drilled in center of head as is usual with other flanging machines. We have also a special machine for turning nozzles in boiler heads with the above all at one heat.

Flues All Flues of six inches diameter and over are riveted to nozzles in heads, which we consider the strongest and best possible way of doing.

Tubes All Tubes are lap-welded, and from mills of first-class reputation, and are carefully and properly expanded in heads and beaded over by skilled workmen.

Rivets We use only the best quality of Rivets, and proportion the diameter of rivet to thickness of the plate. All Rivet Joints are proportioned in accordance with the practice of The Hartford Steam Boiler Inspection and Insurance Co.

Riveting Where it is possible we drive all rivets with our improved Steam Riveting Machines, which is the modern method, insuring a better and closer job than can be done by any other machine, or by hand riveting, where the rivets get cold before the heads are formed. All longitudinal seams in boilers are double riveted, and are placed above the fire line. All seams in domes, above 20 inches in diameter (except heads , are double riveted.

Rivet Holes All holes for rivets are carefully laid out to template. Holes are punched ⅛ inch smaller than rivet and then reamed out by a special machine to suit size of rivet, which brings the holes perfectly true, and drift pins are not found necessary.

Drilling All holes in heads for tubes are carefully drilled to template. After drilling, the outside edge of hole is chamfered off, thereby giving a rounded corner to bead tube over.

Bevelling The edges of all plates are carefully bevelled on a special tool to facilitate caulking and to add a finished appearance to boiler.

Caulking By our method of riveting, boilers are rendered almost tight without caulking ; however, all seams are carefully caulked and made steam tight.

Bracing All flat surfaces are strongly and substantially braced with braces of best refined iron, provided with crow feet or heavy angle iron, all properly distributed throughout boiler. In Locomotive Fire Box Boilers we use stay bolts unless otherwise ordered.

Man-Heads On boilers of 48 inches and over we put in a man-head in front end of boiler under tubes, large enough to allow a man to enter boiler. Also one in rear end above tubes. These man-heads are heavy and strong. We use the "Eclipse" Man-Hole exclusively.

Lugs We put four pressed steel lugs on all standard Tubular Boilers.

Testing, Inspection and Insurance . . . All our standard boilers are thoroughly inspected and tested at 150 pounds per square inch hydrostatic pressure for 100 lbs. steam pressure, and made tight under pressure before shipment. Where purchaser desires to have boilers insured we will obtain policy in a reliable company at the expense of purchaser.

Standard Tubular Boiler.

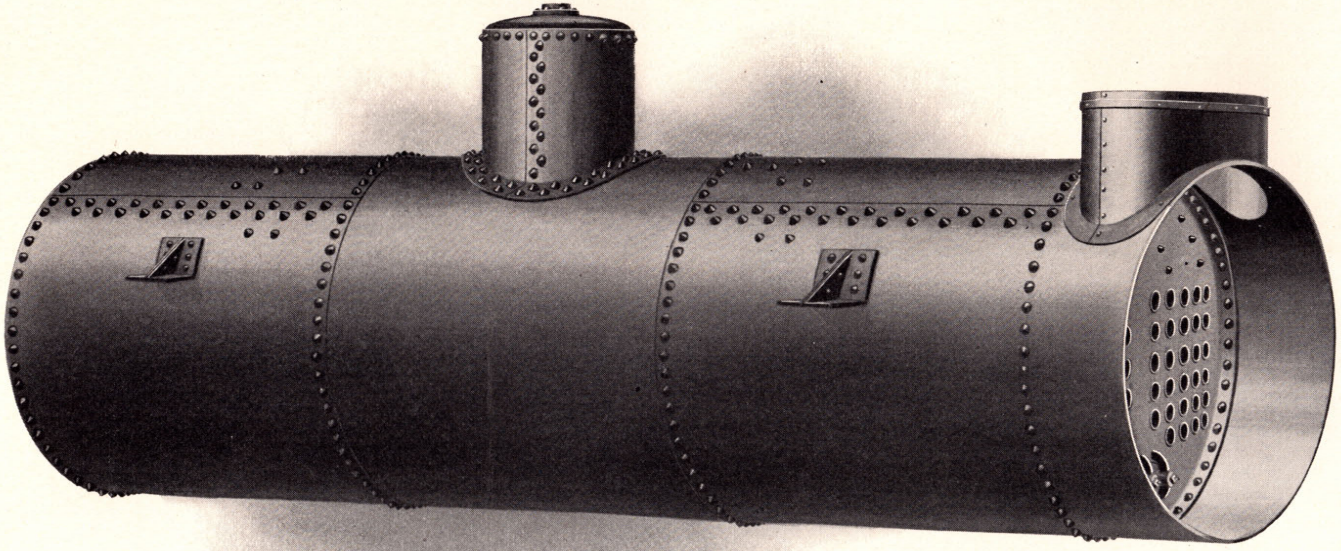


Fig. 1.

All Standard Tubular Boilers with 3 inch, 3½ inch or 4-inch tubes, 14 feet long or under (except 8 feet boilers which are made in one ring), are made in two rings with one plate to ring; above 14 feet, they are made in three rings. Smoke box is formed by extending the shell as shown in cut. All boilers 48 inches and over have man-holes above and below tubes. Smaller sizes have man-hole and hand-hole. Lugs are furnished on all Standard Boilers.

Specifications of Standard Horizontal Tubular Boilers with 3 and 3½-inch Tubes.

Boiler Catalogue Number	100	101	102	103	104	105	106	107	108	109	110	111	112	113	114	115
Horse Power	10	15	20	25	30	35	40	45	50	60	70	80	100	110	125	150
Diameter in inches	32	36	36	40	40	44	44	48	48	54	54	60	66	66	72	72
Length in feet	8	8	10	10	12	12	14	12	14	14	16	16	16	18	16	18
Thickness of Shell in inches	¼	¼	¼	¼	¼	¼	¼	¼	¼	5/16	5/16	5/16	3/8	3/8	3/8	3/8
Thickness of Head in inches	3/8	3/8	3/8	3/8	3/8	3/8	3/8	7/16	7/16	7/16	7/16	7/16	7/16	7/16	7/16	7/16
Diameter of Tubes in inches	3	3	3	3	3	3½	3½	3½	3½	3½	3½	3½	3½	3½	3½	3½
Length of Tubes in feet	8	8	10	10	12	12	14	12	14	14	16	16	16	18	16	18
Number of Tubes	14	22	24	32	32	28	28	34	34	46	46	56	72	72	92	92
Size of Dome in inches	16x16	18x18	18x18	20x20	20x20	22x22	22x22	24x24	24x24	28x28	28x28	30x30	34x34	34x34	36x36	36x36
Approximate weight of Boiler	1,700	2,250	2,600	3,050	3,600	3,950	4,550	4,800	5,300	7,150	7,850	9,050	11,550	12,600	14,100	15,050

SPECIFICATION OF FIXTURES

Length of Grates in inches	33	33	36	36	42	42	48	48	54	48	54	54	54	60	60	66
Width of Grates in inches	30	30	30	36	36	42	42	42	42	48	48	54	60	60	66	66
Size of Safety Valve	1½	2	2	2	2½	2½	3	3	3	3½	3½	4	5	5	5	6
Size of Check and Stop Valve	¾	¾	¾	¾	¾	1	1	1	1	1¼	1¼	1¼	1½	1½	1½	1½
Size of Blow off Valve	1¼	1¼	1¼	1¼	1¼	1½	1½	1½	1½	2	2	2	2	2	2	2
Size of Whistle	3	3	3	3	3½	3½	3½	4	4	4	4	4	4	4	4	5
Diameter of Stack in inches	12	15	15	16	18	20	20	24	24	26	26	28	32	32	36	36
Length of Stack in feet	24	24	30	35	35	35	40	40	40	40	45	45	45	50	50	50
Number of Iron in Stack	16	16	16	16	16	16	16	16	16	16	16	14	14	14	12-14	12-14
Wt. Fixtures with Flush Front	1,550	1,650	1,700	1,900	2,000	2,700	2,800	3,200	3,250	3,700	3,850	4,450	5,050	5,300	6,850	6,900
" " " Half-Arch Front	1,300	1,400	1,500	1,650	1,750	2,050	2,200	2,350	2,400	2,700	2,850	3,250	3,700	3,950	4,200	4,650

Fixtures comprise Front, with doors, grates and bearers, back arch bars, soot door and frame, smoke stack with guy wire (four times length of stack).

Fittings comprise combination water column, with steam gauge and siphon, glass water gauge, and gauge cocks, safety valve, check valve, stop valve, blow-off valve and whistle.

All boilers with 3 inch and 3½-inch tubes are provided with four steel lugs, and have smoke box formed by extending the shell.

All standard boilers are suitable for either full flush or half arch fronts. (See setting plans).

Loops and rods, cross beams and columns, for supporting boiler independent of brick work can be substituted for lugs at an additional cost.

Buckstays and Cross Rods, Wall Plates and Rollers are furnished only when specified, and are charged for extra.

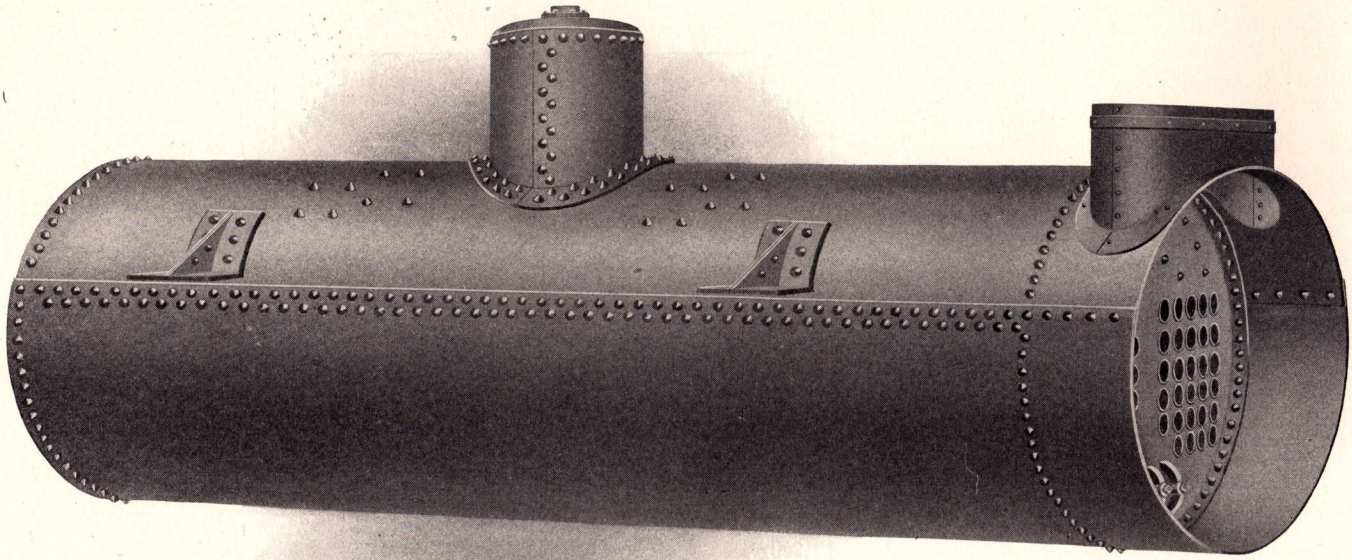


Fig. 2.

The above cut shows a Boiler made with one plate on the bottom and one on the top. While we do not advocate this construction for general use for several reasons, there are some users who prefer it to our standard construction. We have for building boilers 20 feet long in this manner, and will make them when so specified.

Specifications of Standard Horizontal Tubular Boilers with 4-inch Tubes.

BOILER CATALOGUE NUMBER	200	201	202	203	204	205	206	207	208	209	210	211
HORSE POWER	30	35	40	45	50	60	70	80	100	110	125	150
Diameter in inches	40	44	44	48	48	54	54	60	66	66	72	72
Length in feet	12	12	14	12	14	14	16	16	16	18	16	18
Thickness of Shell in inches	¼	¼	¼	¼	¼	5/16	5/16	5/16	⅜	⅜	⅜	⅜
Thickness of Heads in inches	⅜	⅜	⅜	7/16	7/16	7/16	7/16	7/16	7/16	7/16	7/16	7/16
Diameter of Tubes in inches	4	4	4	4	4	4	4	4	4	4	4	4
Length of Tubes in feet	12	12	14	12	14	14	16	16	16	18	16	18
Number of Tubes	20	24	24	30	30	34	34	44	56	56	72	72
Size of Dome in inches	20x20	22x22	22x22	24x24	24x24	28x28	28x28	30x30	34x34	34x34	36x36	36x36
Approximate Weight of Boiler	3600	4100	4700	5050	5600	7050	7700	9050	11550	12600	13700	15100

SPECIFICATIONS OF FIXTURES.

Length of Grates in inches	42	42	48	48	54	48	54	54	54	60	60	66
Width of Grates in inches	36	42	42	42	42	48	48	54	60	60	66	66
Size of Safety Valve	2½	2½	3	3	3	3½	3½	4	5	5	5	6
Size of Check and Stop Valve	¾	1	1	1	1	1¼	1¼	1¼	1½	1½	1½	1½
Size of Blow-off Valve	1¼	1½	1½	1½	1½	2	2	2	2	2	2	2
Size of Whistle	3½	3½	3½	4	4	4	4	4	4	4	4	5
Diameter of Stack in inches	18	20	20	24	24	26	26	28	32	32	36	36
Length of Stack in feet	35	35	40	40	40	40	45	45	45	50	50	50
Number of Iron in Stack	16	16	16	16	16	16	16	14	14	14	12-14	12 14
Weight of Fixtures with Flush Front	2000	2700	2800	3200	3250	3700	3850	4450	5050	5300	6850	6900
Weight of Fixtures with Half Arch Front	1750	2050	2200	2350	2400	2700	2850	3250	3700	3950	4600	4650

Fixtures comprise Front, with doors, grates and bearers, back arch bars, soot door and frame, smoke stack with guy wire (four times length of stack).

Fittings comprise combination water column, with steam gauge and siphon, glass water gauge and gauge cocks, safety valve, check valve, stop valve, blow-off valve and Whistle.

All boilers with 4-inch tubes are provided with four steel lugs, and have smoke box formed by extending the shell.

All standard boilers are suitable for either full flush or half arch fronts. (See setting plans).

Loops and rods, cross beams and columns, for supporting boiler independent of brick work, can be substituted for lugs at an additional cost.

Buckstays and Cross Rods, wall plates and rollers are furnished only when specified, and are charged for extra.

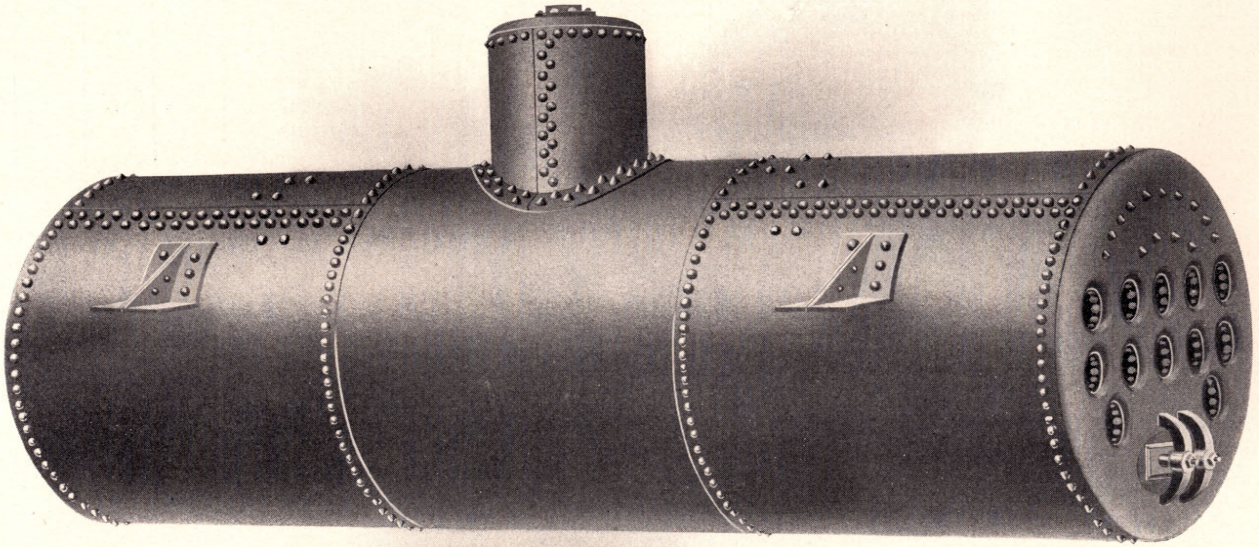


Fig. 3,

The above cut represents a Six-inch Flue Boiler, with shell made in three rings, and with flue holes flanged in on the front head. We turn them out if so desired. All our Standard Boilers with six inch flues, 16 feet long or under, are made in two rings, with one plate to the ring ; above 16 feet long, they are made in three rings as shown above.

Specifications of Standard Horizontal 6-inch Flue Boilers.

BOILER CATALOGUE NUMBER	300	301	302	303	304	305	306	307	308
HORSE POWER	25	30	35	40	50	60	75	90	112
Diameter in inches	40	44	44	48	50	54	60	66	72
Length in feet	14	14	16	16	18	18	20	20	20
Thickness of Shell in inches	¼	¼	¼	¼	5/16	5/16	5/16	⅜	⅜
Thickness of Heads in inches	⅜	⅜	⅜	⅜	7/16	7/16	7/16	7/16	7/16
Number of Tubes	7	8	8	10	12	12	16	20	26
Size of Dome in inches.	20x20	22x22	22x22	24x24	24x24	28x28	30x30	34x34	36x36
Approximate Weight of Boilers	3500	4000	4900	5350	7400	8700	11,000	12,800	14,800

SPECIFICATIONS OF FIXTURES.

Length of Grates in inches	42	42	48	48	48	54	60	60	60
Width of Grates in inches	36	42	42	42	48	48	54	60	66
Size of Safety Valve in inches.	2½	2½	2½	3	3	3	4	4	4
Size of Check and Stop Valve in inches	¾	¾	1	1	1	1¼	1¼	1¼	1½
Size of Blow-off Valve in inches	1¼	1½	1½	1½	1½	1½	2	2	2
Size of Whistle in inches	3	3½	3½	4	4	4	4	4	4
Diameter of Stack in inches	18	20	20	20	22	22	24	28	32
Length of Stack in feet.	40	40	40	45	45	50	50	50	50
Number of Iron in Stack.	16	16	16	16	16	16	16	14	14
Weight of Fixtures with Flush Front.	2050	2700	2800	3050	3250	3800	4600	5050	6550
Weight of Fixtures with Half-arch Front.	2000	2300	2400	2600	2700	3150	3850	4400	4850

Fixtures comprise Front, with doors, grates and bearers, back-arch bars, soot door and frame, smokestack with guy wire (four times the length of stack.)

Fittings comprise combination water column with steam gauge and siphon glass water gauge, and gauge cocks, safety valve, check valve, stop valve, blow-off valve and whistle.

All Boilers with six-inch flues are provided with four steel lugs, and have smoke box formed by bolting on extension to the shell.

All Standard Boilers a e suitable for either full flush or half-arch fronts. (See setting plans.)

Loops and rods, cross-beams and columns, for supporting boiler independent of brick work, can be substituted for lugs at an additional cost.

Buckstays and cross rods, wall plates and rollers, are furnished only when specified, and are charged for extra.

Specifications of Standard Horizontal Two-Flue Boilers.

Boiler Catalogue Number	400	401	402	403	404	405	406	407	408	409
Horse Power	10	12	15	20	25	30	35	40	45	50
Diameter in inches	30	32	32	36	40	42	44	48	48	50
Length in feet	10	12	14	16	18	20	22	24	26	28
Thickness of Shell in inches	¼	¼	¼	¼	¼	¼	¼	¼	¼	5/16
Thickness of Heads in inches	⅜	⅜	⅜	⅜	⅜	⅜	⅜	7/16	7/16	7/16
Diameter of Flues in inches	10	10	10	12	13	14	15	18	18	18
Thickness of Flues in inches	¼	¼	¼	¼	¼	¼	¼	5/16	5/16	5/16
Size of Dome in inches	15x15	16x16	16x16	18x18	20x20	22x22	22x22	24x24	24x24	26x26
Approximate Weight of Boilers	2,100	2,350	2,550	3,300	4,250	4,750	5,200	7,500	8,500	10,000
Approximate Weight of Boilers & Fixtures	3,950	4,250	4,500	5,400	6,500	7,500	8,000	10,500	11,750	13,250

SPECIFICATIONS OF FIXTURES.

Length of Grates in feet	3	3½	4	4	4	4½	4½	4½	5	5
Width of Grates in inches	30	30	30	36	42	42	42	48	48	48
Size of Safety Valve in inches	1½	1½	2	2	2	2½	2½	3	3	3
Size of Check and Stop Valve in inches	¾	¾	¾	¾	¾	¾	1	1	1	1
Size of Blow-off Valve in inches	1¼	1¼	1¼	1¼	1¼	1¼	1¼	1¼	1½	1½
Size of Whistle in inches	3	3	3	3	3½	3½	4	4	4	4
Diameter of Stack in inches	15	15	15	18	18	22	24	26	26	26
Length of Stack in feet	30	30	30	30	35	40	40	40	50	50
Number of Iron in Stack	16	16	16	16	16	16	16	16	16	16
Approximate Weight of Fixtures	1,850	1,900	1,950	2,100	2,250	2,750	2,800	3,000	3,250	3,250

Fixtures comprise Half-Arch Front, with doors, grates and bearers, back-arch bars, soot door and frame, backstand, smoke stack with guy wire (four times length of stack).

Fittings comprise combination water column with steam gauge and siphon glass water gauge, and gauge cocks, safety valve, check valve, stop valve, blow-off valve, and whistle.

Large hand-hole in front end under flues, and man-hole in rear end above flues.

No loops or lugs furnished on Two-Flue Boilers. (See Setting Plan No. 2.)

Buckstays and cross rods are furnished only when specified, and are charged for extra.

Specifications of Standard Cylinder Boilers.

Boiler Catalogue Number	500	501	502	503	504	505	506	507
Horse Power	13	14	16	18	21	23	26	28
Diameter of Boiler in inches	26	28	30	32	34	36	38	40
Length of Boiler in feet	30	30	30	30	36	36	40	40
Thickness of Shell in inches	¼	¼	¼	¼	¼	¼	¼	¼
Thickness of Heads in inches	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜
Size of Dome in inches	14x14	14x14	16x16	16x16	18x18	18x18	20x20	20x20
Approximate Weight of Boiler	3100	3200	3300	3850	4850	5500	6400	6700

Specifications of Fixtures.

Length of Grate in feet	5	5	5	5	5	5	5	5
Width of Grates in inches	24	30	30	30	36	36	36	42
Size of Safety Valve in inches	1½	1½	1½	2	2	2	2	2
Size of Check and Stop Valve in inches	¾	¾	¾	¾	¾	¾	¾	¾
Size of Blow-off Valve in inches	1¼	1¼	1¼	1¼	1¼	1¼	1½	1½
Size of Whistle in inches	3	3	3	3	3	3	3½	3½
Diameter of Stack in inches	16	18	18	20	20	22	22	24
Length of Stack in feet	30	30	30	30	40	40	50	50
Approximate weight of Boiler and Fixtures	5000	5200	5400	6200	7300	8050	9100	9600

Fixtures comprise half-arch front with doors, grates and bearers, stack plate, soot door and frame, back stand, smoke stack with guy wire (four times length of stack.)

Fittings comprise safety valve, check, stop and blow off valves, whistle, glass water gauge, gauge cocks and steam gauge and siphon.

Buckstays and cross rods are furnished only when specified, and are charged for extra.

Portable Boiler

Locomotive Style.

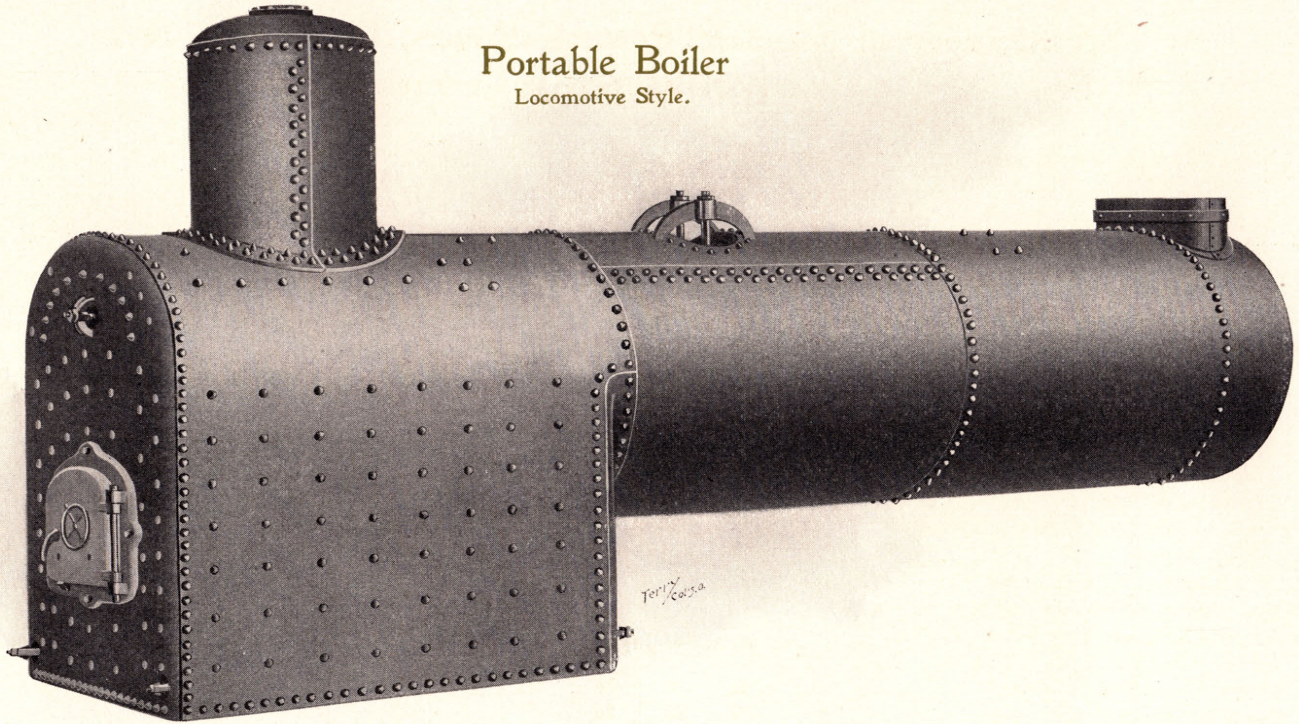


Fig. 4

The above cut represents our Portable Boiler with Water Front, Open Bottom, and not mounted. We can mount these boilers on skids or wheels, if desired, at an additional cost. We provide all boilers with sufficient hand-holes, conveniently located, to afford ready access for cleaning.
All boilers over 36 in. diameter have manhole on shell.

Specifications of Standard Portable Boilers, Locomotive Style.

WATER FRONT AND OPEN BOTTOM.

Boiler Catalogue Number	600	601	602	603	604	605	606	607	608	609	610	611
Horse Power	15	20	25	30	35	40	50	60	70	80	100	125
Diameter in inches	32	34	36	36	40	42	44	48	54	56	60	62
Length of Fire Box in inches	44	52	52	52	52	54	64	64	64	64	64	66
Height of Fire Box in inches	33	36	38	40	42	46	48	48	52	54	56	58
Width of Fire Box in inches	26	28	30	30	34	36	38	42	48	50	54	56
Number of 3-inch Tubes	26	28	34	34	40	43	48	56	60	66	76	96
Length of Tubes in inches	78	90	96	120	102	120	132	144	150	156	168	180
Thickness of Shell	¼	¼	¼	¼	¼	¼	¼	¼	5/16	5/16	⅜	⅜
Thickness of outside of Fire Box	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5/16	⅜	⅜
Thickness of Furnace Plate	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5/16
Thickness of Tube Sheets and Heads	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜
Size of Dome	16x16	18x18	18x18	18x18	20x20	22x22	22x22	24x24	28x28	28x28	30x30	32x32
Size of Safety Valve in inches	1½	2	2	2	2½	3	3	3	3	3	4	4
Size of Blow-off Valve in inches	1	1	1¼	1¼	1¼	1¼	1¼	1½	1½	1½	1½	1½
Size of Check and Stop Valve in inches	¾	¾	¾	1	1	1	1	1¼	1¼	1¼	1¼	1½
Size of Whistle	2½	2½	2½	2½	3	3	3	4	4	4	4	4
Diameter of Stack in inches	16	18	18	18	20	20	22	24	26	26	28	32
Length of Stack in feet	20	25	25	25	25	25	30	35	35	35	35	40
Weight of Boiler	3,600	4,000	4,600	4,675	5,100	6,300	7,500	9,400	10,750	11,200	12,300	14,000
Weight of Boiler and Fixtures	4,400	5,000	5,750	5,900	6,400	7,700	8,900	10,900	12,850	13,400	14,700	16,800

Can make Water Bottom and Water Front same as above at an additional cost.

Fixtures and fittings for the above boiler comprise grates, steam gauge and siphon, water gauge, gauge cocks, safety valve, blow-off, check and stop valve, whistle, smoke stack and guy wire.

The shell is extended to form the smoke box, and is provided with stack saddle and smoke doors.

Fire Box Heating Boiler.

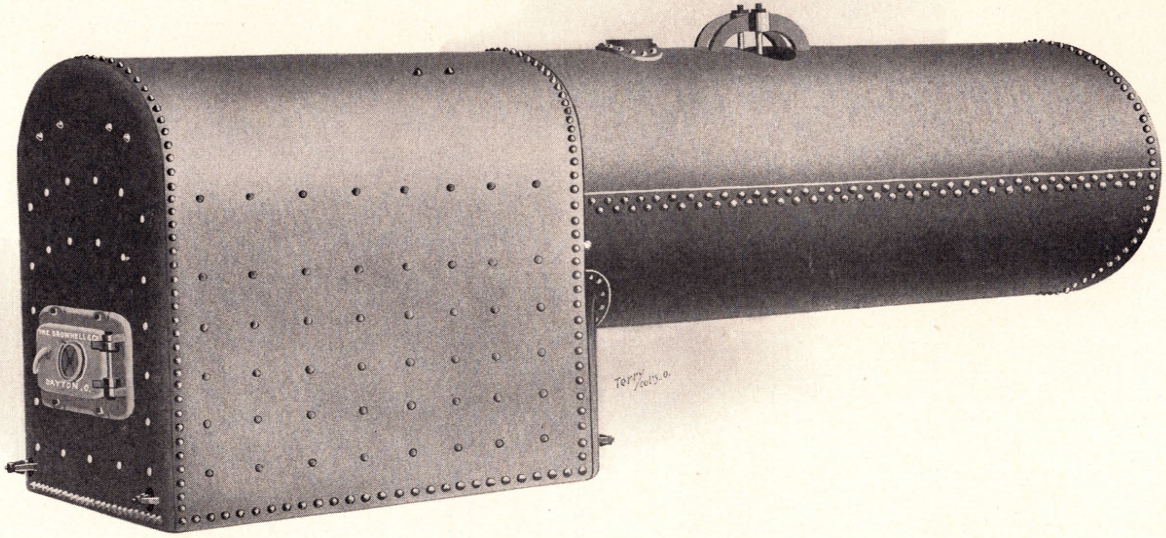


Fig. 5.

The above is a cut of Fire Box Boiler designed for use in steam heating of buildings, the same being recommended and used by many of the steam heating contractors in the larger cities.

Horizontal Fire Box Boilers for Steam Heating.

FOR BRICK SETTING, WITHOUT DOMES.

BOILER CATALOGUE NUMBER	700	701	702	703	704	705	706	707	708	709	710	711
Length over all in feet	6½	7½	8½	7½	9	10½	8½	10	11½	10½	12	13½
Diameter of Shell in inches	30	30	30	36	36	36	42	42	42	48	48	48
Number of Tubes	40	40	40	40	40	40	52	52	52	48	48	48
Diameter of Tubes in inches	2	2	2	2½	2½	2½	2½	2½	2½	3	3	3
Length of Tubes in inches	48	54	60	54	66	78	60	72	84	78	90	102
Length of Fire Box in inches	26	32	38	32	38	44	38	44	50	44	50	56
Width of Fire Box in inches	24	24	24	30	30	30	36	36	36	42	42	42
Height of Fire Box in inches	31	31	31	36	36	36	41	41	41	45	45	45
Thickness of Shell	¼	¼	¼	¼	¼	¼	¼	¼	¼	¼	¼	¼
Thickness of Heads and Fire Box	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5/16	3/8	3/8	3/8
Depth of Water Leg in inches	10	10	10	11	11	11	12	12	12	12	12	12
Fire Door Opening	10x15	10x15	10x15	12x18	12x18	12x18	12x18	12x18	12x18	12x18	12x18	12x18
Weight of Boiler only	1,800	2,000	2,300	2,900	3,300	3,700	4,300	4,800	5,300	5,800	6,400	7,000
Weight of Castings complete	400	400	480	515	550	595	620	695	745	795	840	1,095
Heating Surfaces — Fire Box	25	28	32	37	41	45	50	56	61	65	71	76
Heating Surfaces — Tubes	101	114	126	138	168	197	198	236	275	290	335	379
Heating Surfaces — Shell	26	30	36	36	43	50	47	55	63	66	76	86
Total Heating Surface, square feet	152	172	194	211	252	292	295	347	399	421	482	541
Grate Area, square feet	4.3	5.3	6 3	6.7	8.	9.2	9.5	11.	12.5	13.	14.7	16 4
Radiation will carry, direct	800	900	1,100	1,200	1,500	1,800	1,800	2,200	2,600	2,800	3,300	3,800

With each Boiler we furnish fire door and frame, set of common grates, ash pit door with swinging damper, and soot door and frame.

Submerged Tubular Boiler.

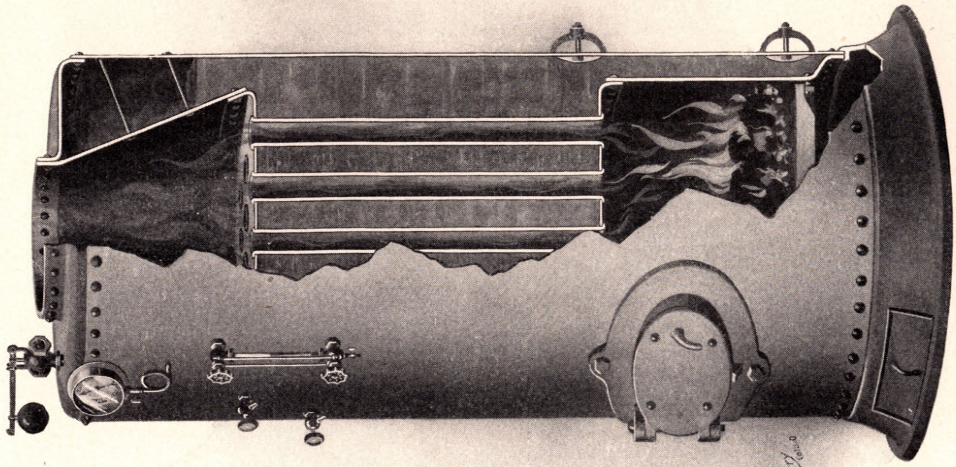


Fig. 6.

Specifications of Standard Submerged Tubular Boilers.

Boiler Catalogue Number	900	901	902	903	904	905	906	907	908	909	910	911	912
Horse Power	5	8	10	12	15	18	20	25	30	35	40	45	50
Diameter in inches	24	30	30	30	36	36	42	42	48	48	48	54	54
Height in inches	60	60	72	84	84	96	96	108	102	108	120	114	120
Height of Fire Box	24	25	28	28	30	30	30	30	30	30	30	30	30
Number of Tubes	31	54	54	54	68	68	85	85	132	132	132	174	174
Diameter of Tubes in inches	2	2	2	2	2	2	2	2	2	2	2	2	2
Length of Tubes in inches	18	18	27	38	38	48	48	60	45	51	63	54	60
Thickness of Shell	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	1/4	5/16	5/16
Thickness of Fire Box	9/32	9/32	9/32	9/32	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5/16
Thickness of Heads	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	7/16	7/16	7/16	7/16	7/16
Thickness of Cone	9/32	9/32	9/32	9/32	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5/16
Size of Safety Valve in inches	1	1 1/4	1 1/4	1 1/2	1 1/2	1 1/2	2	2	2	2 1/2	2 1/2	2 1/2	3
Size of Check Valve in inches	1/2	1/2	1/2	1/2	3/4	3/4	3/4	3/4	3/4	3/4	1	1	1
Size of Stop Valve in inches	1/2	1/2	1/2	1/2	3/4	3/4	3/4	3/4	3/4	3/4	1	1	1
Size of Blow-off in inches	1	1	1	1	1	1	1	1	1 1/4	1 1/4	1 1/4	1 1/4	1 1/4
Diameter of Stack in inches	12	15	15	15	18	18	20	20	24	24	24	26	26
Weight of Boiler	700	1075	1250	1450	1930	2000	2600	3250	4000	4200	4600	5200	5400
Weight of Boiler and Fixtures	1050	1250	1450	1650	2400	2900	3325	4275	5500	5700	6100	7275	7475

Fixtures for the above include base, grates, doors, glass water gauge, steam gauge and siphon, gauge cocks, safety valve, check valve, stop valve, blow-off cock, smoke stack Vertical seams double riveted.

All boilers have hand-holes above flue sheet and at bottom of fire box for cleaning out.

All boilers over 36 inches in diameter have shell extended 8 inches to form ash pit, and have flat base plate.

Plain Vertical Tubular Boiler.

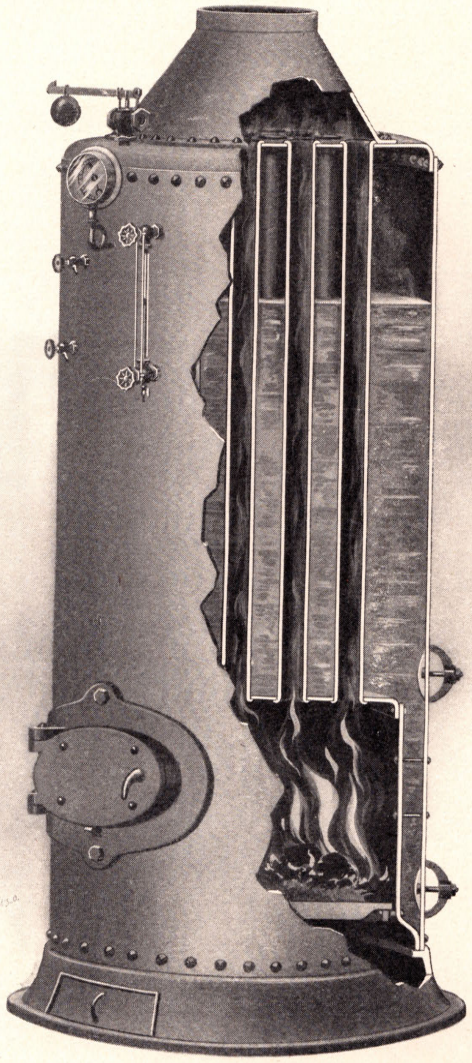


Fig. 7.

Specifications of Standard Plain Vertical Tubular Boilers.

Boiler Catalogue Number	800	801	802	803	804	805	806	807	808	809	810	811	812
Horse Power	5	8	10	12	14	16	20	25	30	35	40	45	50
Diameter in inches	24	30	30	36	36	36	42	42	42	48	48	48	48
Height in inches	60	60	72	72	84	96	96	108	120	96	102	108	120
Height of Fire Box in inches	24	28	28	30	30	30	30	30	30	30	30	30	30
Number of Tubes	31	49	49	61	61	61	79	85	91	138	144	144	144
Diameter of Tubes in inches	2	2	2	2	2	2	2	2	2	2	2	2	2
Length of Tubes in inches	36	32	44	42	54	66	66	78	90	66	72	78	90
Thickness of Shell	¼	¼	¼	¼	¼	¼	¼	¼	¼	¼	¼	¼	¼
Thickness of Fire Box	9/32	9/32	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5/16
Thickness of Heads	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜	7/16	7/16	7/16	7/16
Size of Safety Valve in inches	1¼	1½	1½	1½	1½	1½	2	2	2	2½	2½	2½	3
Size of Check and Stop Valve in inches	½	½	½	¾	¾	¾	¾	¾	¾	¾	1	1	1
Size of Blow off Valve in inches	1	1	1	1	1	1	1	1	1¼	1¼	1¼	1¼	1¼
Diameter of Stack in inches	12	15	15	18	18	18	20	20	20	24	24	24	24
Weight of Boiler	1,000	1,200	1,400	1,700	2,000	2,500	3,200	3,500	3,800	4,000	4,400	4,600	4,900
Weight of Boiler and Fixtures	1,350	1,500	1,650	1,950	2,350	2,850	3,925	4,225	4,525	5,500	5,900	6,100	6,400

Boilers over 36 inches in diameter have shell extended eight inches to form ash pit, and have flat base plate.
Vertical seams double riveted. All boilers have hand-holes above flue sheet and at bottom of fire box for cleaning out.
Fixtures for the above Boilers include Base, Grates, Doors and sheet iron hood.
Fittings include Glass Water Gauge, Gauge Cocks, Steam Gauge and Siphon, Safety Valve, Check Valve, Stop Valve and Blow-off Valve.

Single Flue Vertical Boiler.

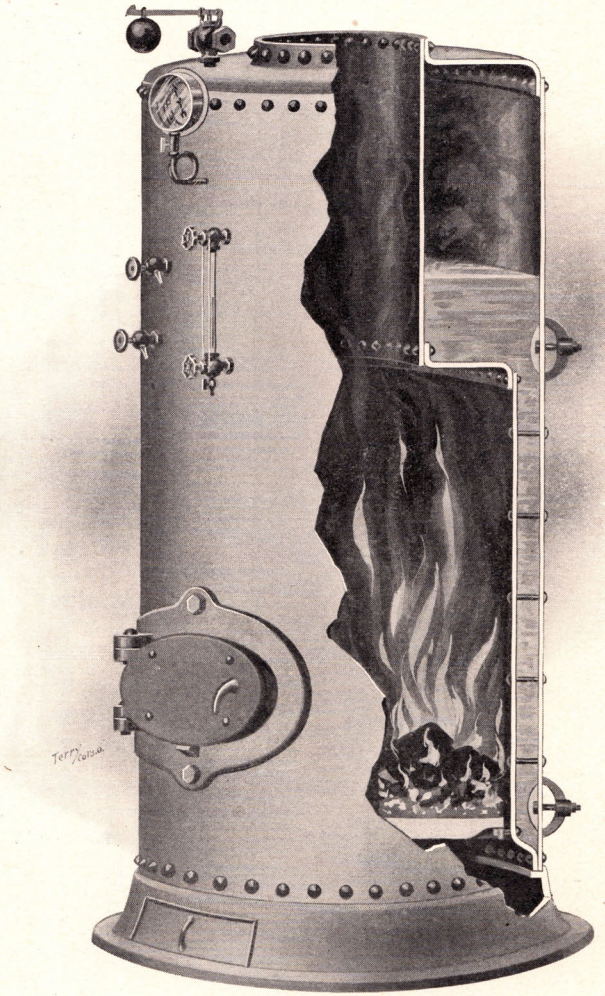


Fig. 8.

This style of boiler is used largely in slaughter houses, railway pumping stations and tobacco warehouses, for the reason that it does not require as close attention as Tubular Upright Boilers.

Specifications of Standard Single Flue Vertical Boilers.

Boiler Catalogue Number	1000	1001	1002	1003	1004	1005	1006	1007	1008	1009	1010	1011
Horse Power	3	4	4½	5	6	7	7½	9	10	12	15	18
Diameter in inches	24	26	30	30	30	30	36	36	36	42	42	48
Height in inches	60	72	60	72	84	96	72	84	96	96	120	120
Height of Fire Box in inches	44	48	44	48	56	70	48	56	66	66	84	84
Diameter of Flue in inches	6	7	8	8	8	8	10	10	10	12	14	14
Thickness of Shell	¼	¼	¼	¼	¼	¼	¼	¼	¼	¼	¼	¼
Thickness of Fire Box	¼	¼	9/32	9/32	9/32	9/32	5/16	5/16	5/16	5/16	5/16	5/16
Thickness of Flue	¼	¼	¼	¼	¼	¼	¼	¼	¼	¼	5/16	5/16
Thickness of Heads	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	7/16
Size of Safety Valve in inches	1	1	1	1¼	1¼	1½	1½	1½	1½	1½	1½	2
Size of Check and Stop Valve	½	½	½	½	½	½	½	½	½	½	¾	¾
Size of Blow-off Cock in inches	1	1	1	1	1	1	1	1	1	1	1	1
Diameter of Stack in inches	8	9	10	10	10	10	12	12	12	14	16	16
Approximate weight of Boiler	875	940	1040	1140	1300	1400	1500	1650	1900	2240	2600	3050
Approximate weight of Boiler and Fixtures	1225	1265	1300	1440	1600	1700	1850	2000	2250	2980	3385	3750

Besides those mentioned above, fixtures include base, grates, glass water gauge, steam gauge and siphon, and gauge cocks.
All boilers over 36 inches in diameter have ash pit extension and flat base plate.

Scotch Boiler.

This is a Horizontal Boiler, with one or two large flues running lengthwise through it. The fire box of the boiler is formed by this flue which is entirely surrounded by a water space. The grates are placed in the front end of the flue. The fire passes through the flue to the combustion chamber at the rear end of the boiler, and then returns through a number of small tubes to the smoke bonnet at the front end The tubes are always below the water line.

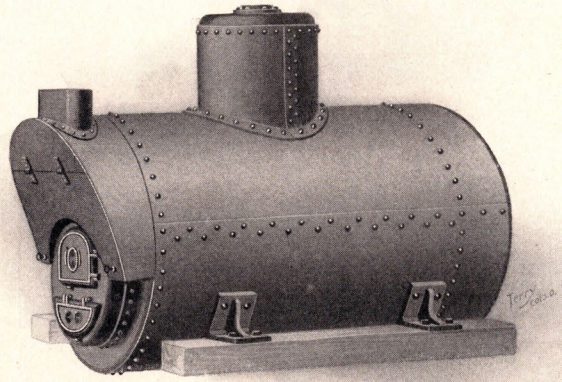


Fig. 9.

The Boiler is compact, and economical in the use of fuel. All Boilers above 37 horse power have two fire flues These Boilers are made of 60000 T. S. open hearth, homogeneous flange steel On account of their compactness and low center of gravity, these Boilers are very desirable for launches, and when wanted for use in boats are made of Marine Steel, and built to conform to the United States marine laws. Hand holes for cleaning out sediment are placed in every one.

SPECIFICATIONS OF STANDARD SCOTCH BOILERS.

BOILER CATALOGUE NUMBER	1100	1101	1102	1103	1104	1105	1106	1107	1108	1109	1110	1111	1112	1113
HORSE POWER	9	12	15	18	23	30	37	48	54	60	68	75	82	90
Diameter and Length of Shell, inches	36x48	36x54	42x54	44x60	48x66	54x72	60x104	66x92	66x104	66x116	78x106	78x118	78x130	78x142
Thickness of Shell	¼	¼	¼	¼	¼	5/16	5/16	⅜	⅜	⅜	7/16	7/16	7/16	7/16
Thickness of Heads	⅜	⅜	⅜	⅜	7/16	7/16	7/16	7/16	7/16	7/16	½	½	½	½
Number of Fire Box Flues	1	1	1	1	1	1	1	2	2	2	2	2	2	2
Thickness of Flues	5/16	5/16	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜
Diam. and L'gth of Fire Box Flues, inch	18x40	18x46	21x46	22x50	24x54	26x60	26x92	24x78	24x90	24x102	26x90	26x102	26x114	26x126
Number of Tubes	32	40	52	58	68	82	44	50	50	50	75	75	75	75
Diameter and Length of Tubes, inches	2x40	2x46	2x46	2x50	2x54	2x60	3x92	3x78	3x90	3x102	3x90	3x102	3x114	3x126
Diameter and Height of Dome, inches	18x18	18x18	20x20	22x22	24x24	28x28	30x30	34x34	34x34	34x34	36x36	36x36	36x36	36x36
Size of Pop Safety Valve	1	1¼	1¼	1½	2	2	2	2½	2½	3	3	3	3½	3½
Size of Check and Stop Valve	½	¾	¾	¾	¾	¾	1	1	1	1	1	1¼	1¼	1¼
Size of Blow-off Valve	1	1	1	1	1	1	1¼	1¼	1¼	1½	1½	1½	1½	1½
Size of Whistle	2	2	2	2½	2½	3	3	3	3	3½	3½	3½	3½	3½
Length of Grates	24	30	30	36	36	36	42	36	36	42	48	48	54	54
Heating Surface, square feet	73	98	121	145	181	242	300	384	432	480	540	600	660	720
Weight, pounds	2.250	2,550	2,950	3,150	4.150	4,900	8.200	10.600	11.350	12.100	15.000	15.860	16.600	17,400

The Brownell Semi-Portable Outfit.

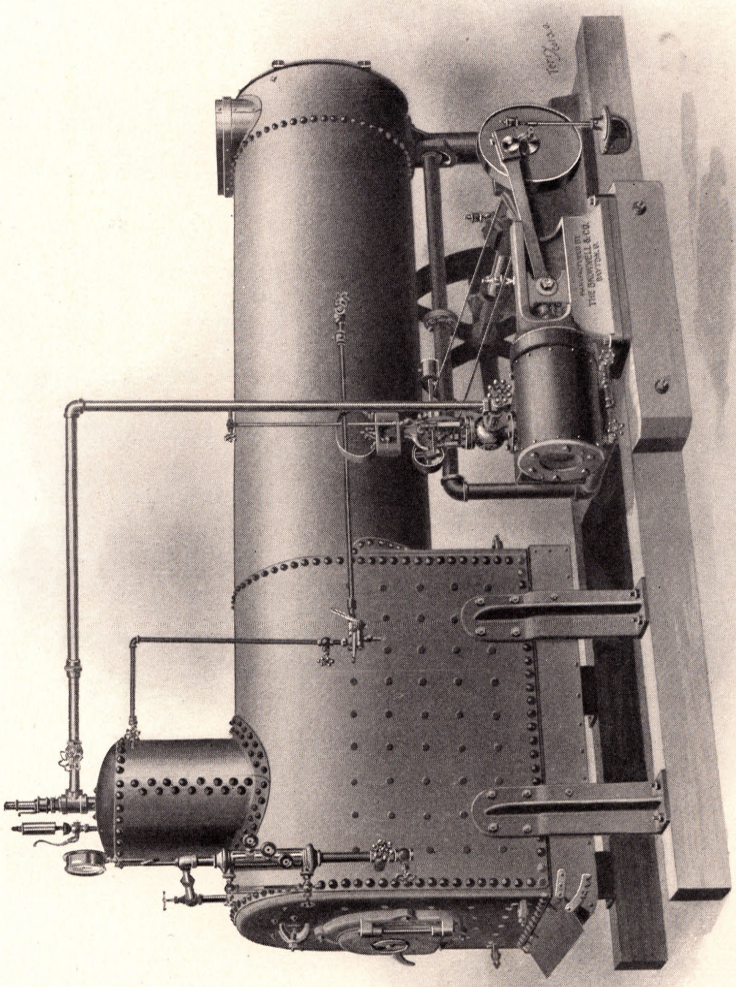


Fig. 10.

Horse Power.	Size of Eng.		Band Wheel.		Speed.	Length of Fire Box.	Width of Fire Box.	Height of Fire Box.	Diam of Waist.	No. of 3-in Tubes.	Length of Tubes.	Thickness of Shell.	Thickness of Heads.	Diam. of Stack.	Length of Stack.	Shipping Weight.
	Diam.	Stroke.	Diam.	Face.												
18	7	10	40	8½	275	52	28	36	34	28	90	¼	5/16	18	25	7,280
25	8	10	40	8½	275	52	30	38	36	34	96	¼	5/16	18	25	8.100
30	9	12	48	10½	250	52	30	40	36	34	120	¼	3/8	18	25	9 060
40	10	12	48	10½	250	54	34	46	42	43	120	5/16	3/8	20	25	11.120
50	11	14	60	12½	225	64	38	48	44	48	132	5/16	3/8	22	30	13.300
60	12	14	60	12½	225	64	42	52	48	56	144	5/16	3/8	24	35	15.300

Each outfit is furnished with pop safety valve, whistle, steam gauge and siphon, water column and gauge cocks, governor and belt, cylinder drip valves, centrifugal oiler for crank pin, sight feed oil cups, wrenches, injector piped to boiler, smoke stack and guy wire.

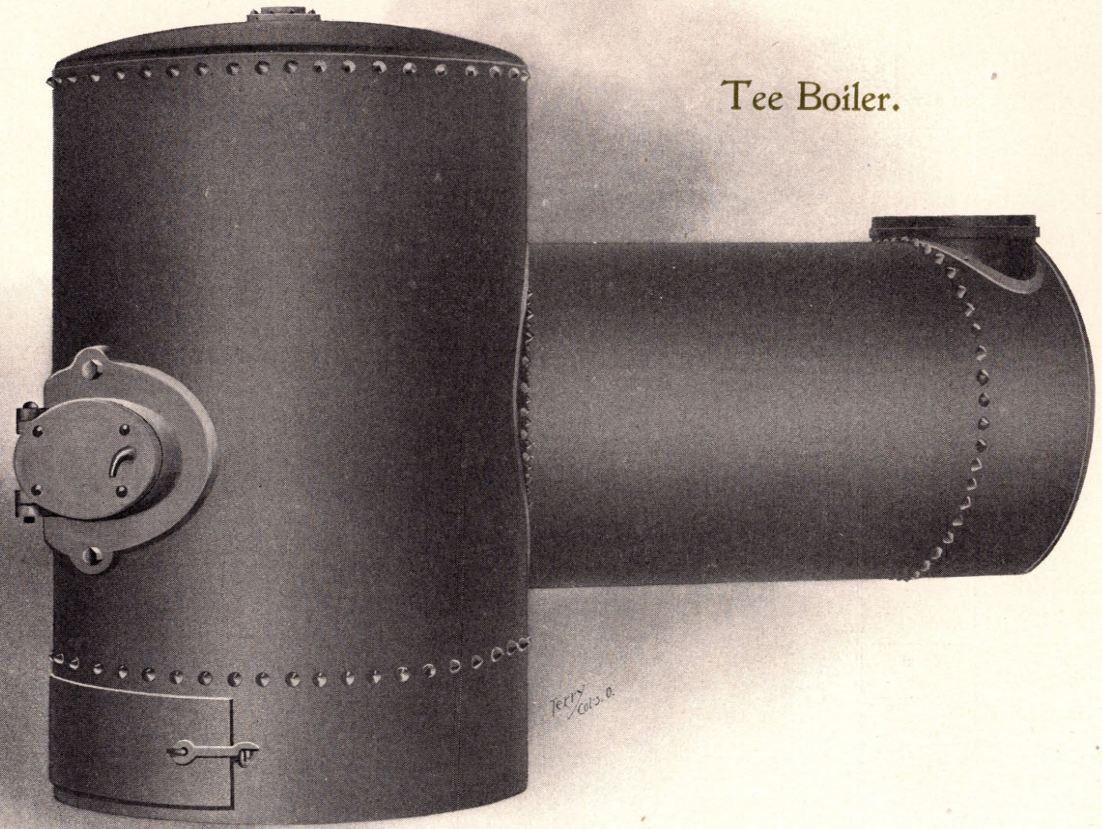


Fig. 11.

The above cut represents a type of boiler of which we build a great many, which we call a "Tee" Boiler. The construction can be readily understood from the cut.

Specifications of Standard "Tee" Boilers.

Boiler Catalogue Number	1300	1301	1302	1303	1304	1305	1306	1307	1308
Horse Power	4	6	7	10	12	14	16	20	22
Diameter of Upright in inches	28	30	34	38	40	42	44	46	46
Height of Upright in inches	48	50	62	64	64	64	66	66	66
Diameter of Waist in inches	20	24	24	26	28	30	32	34	34
Length of Waist in inches	36	36	42	44	44	46	48	52	66
Height of Fire Box in inches	24	26	26	30	30	32	32	37	37
Number of Tubes	14	22	14	16	22	24	26	32	32
Diameter of Tubes in inches	2½	2½	3	3	3	3	3	3	3
Length of Tubes in inches	33	33	38	40	42	42	43	48	62
Thickness of Shell in inches	¼	¼	¼	¼	¼	¼	¼	¼	¼
Thickness of Fire Box in inches	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5/16	5/16
Thickness of Tube Sheet and Heads in inches	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜	⅜
Size of Safety Valve in inches	1	1¼	1¼	1¼	1½	1½	1½	2	2
Size of Check Valve in inches	½	½	½	½	½	¾	¾	¾	¾
Size of Stop Valve in inches	½	½	½	½	½	¾	¾	¾	¾
Size of Blow-off Valve in inches	1	1	1	1	1	1	1	1	1
Diameter of Stack in inches	10	11	11	12	13	14	15	17	17
Length of Stack in feet	6	7	7	8	8	9	10	12	12
Weight of Boiler	1050	1250	1400	1650	1850	2000	2200	2500	2750
Weight of Boiler and Fixtures	1595	1810	2010	2375	2705	2995	3215	3615	3865

Fixtures comprise Grates, Fire Door, Ash Pit Door, Smoke Door, Flat Base Plate, Glass Water Gauge, Gauge Cocks, Steam Gauge and Siphon, Safety Valve, Check Valve, Stop Valve, and Blow-off Valve.

All Boilers are provided with Hand Holes in Water leg for cleaning out.

High Pressure Boilers.

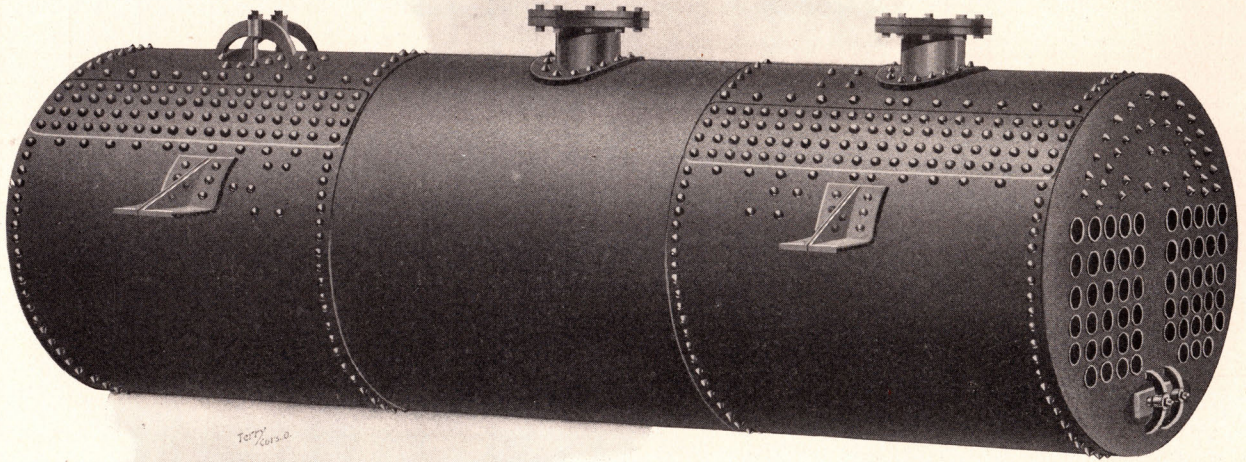


Fig 12

The above cut represents a boiler made to carry a higher pressure than our Standard. We specially design and construct boilers for use in electric light stations and factories where a high pressure is required, and are pleased to quote prices on application. All boilers, unless otherwise ordered, will be provided with four pressed steel lugs.

BOILER FIXTURES.

On the following pages we illustrate our Boiler Fronts, Grates, Smoke Breechings, and other Fixtures.

Boiler Fronts. We illustrate on pages 31-34 our standard full flush front and standard half arch front. These fronts are substantial, neat in appearance, well made, and properly proportioned to give the best results. We have abandoned the practice of furnishing a cast iron fire front liner for supporting the brick arch over fire doors. This liner soon burns out and allows the brick work around the doors to come down. Our experience has demonstrated that if the front is bricked up complete and an arch of good fire brick sprung over the fire doors, the job will last longer and give better satisfaction than with any other arrangement.

Smoke Breechings. For two boilers, either the horizontal breeching shown on page 36, or the "Y" breeching shown on page 37, makes a good arrangement. If more than two boilers are set together, the horizontal breeching leading into stack at side is the best arrangement. We have facilities for making promptly any size or shape breeching, and will be pleased to quote prices on application.

Back Flue Plates. Instead of the flat flue plate, we now use on all standard boilers above 48 inches in diameter the skeleton arch bars. These bars are intended to be filled between with fire brick, and on the larger sizes where the space to span is greater, they make a much more durable arrangement than the flat plate, and also give the flames an easy curved return into the boiler. On boilers of 48 inches and under we use the flat plate for the reason that on the smaller sizes there is not sufficient room between the flues and manhole for the arch bars.

Smoke Box Extensions. All standard horizontal tubular boilers are furnished with full extensions, whether intended for full flush or half arch fronts, and are provided with stack sadbles. (See setting plans, pages 39 and 41.)

Back View of Flush Front.

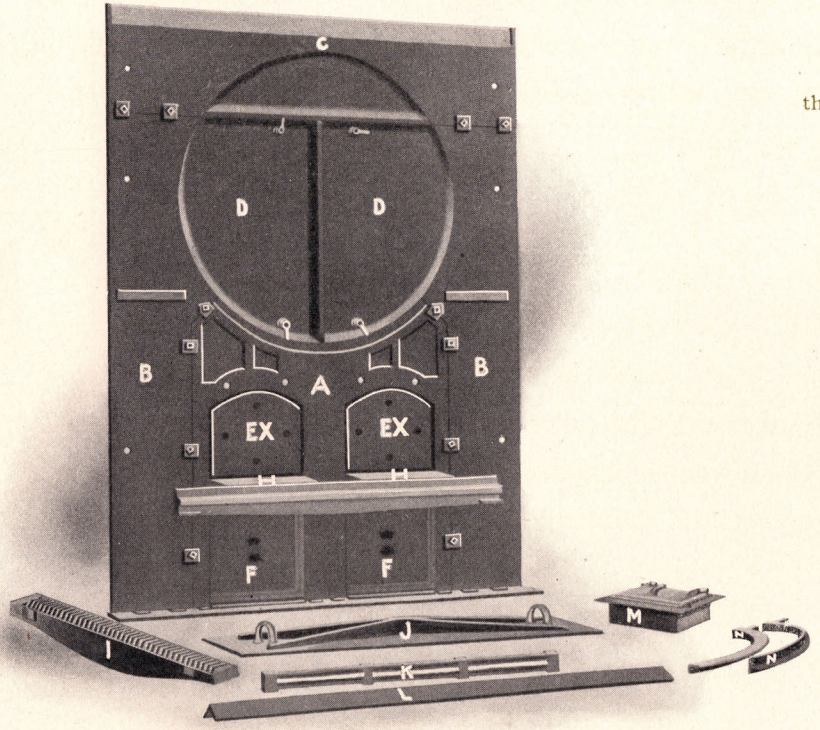


Fig. 13.

A—Is the center piece with fire and ash pit doors; this piece is made very heavy.

BB—Are the side pieces.

C—Is the top arch pieee.

DD—Are the smoke doors, opening to right and left.

EX—Fire doors, showing linings on them.

FF—Ash pit doors.

G—Front grate bar rest.

HH—Coking plates.

I—Tupper grate bar.

J- Flat flue plate.

K—Common grate bar.

L—Rear grate bar rest.

M—Soot door and frame.

NN- Skeleton arch flue bars. This style flue bar is furnished on all standard boilers above 48 inches in diameter; on boilers 48 inches and under, the flat plate (J) is used. (See page 30.)

Full Flush Front.

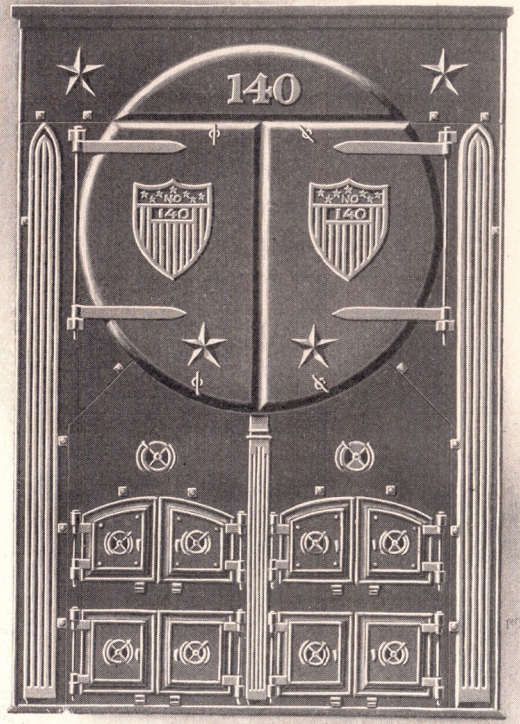


Fig. 14.

For 72-Inch Boilers.

Full Flush Front.

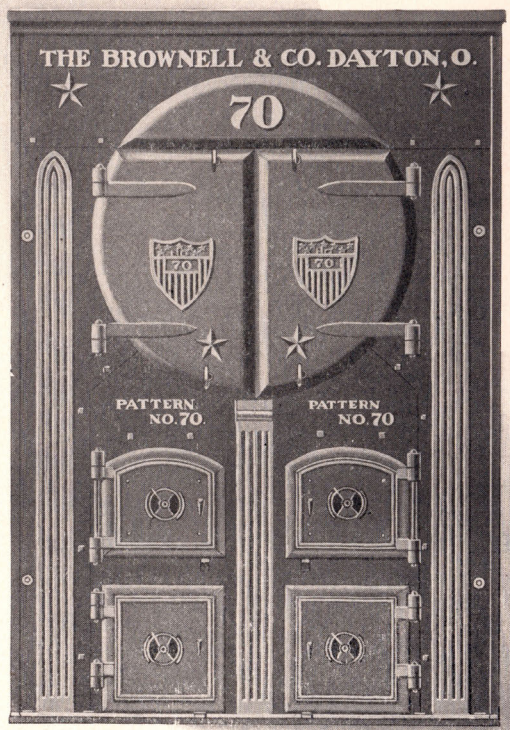


Fig. 15.

For Boilers 44 in. to 66 in. Inclusive.

Full Flush Front.

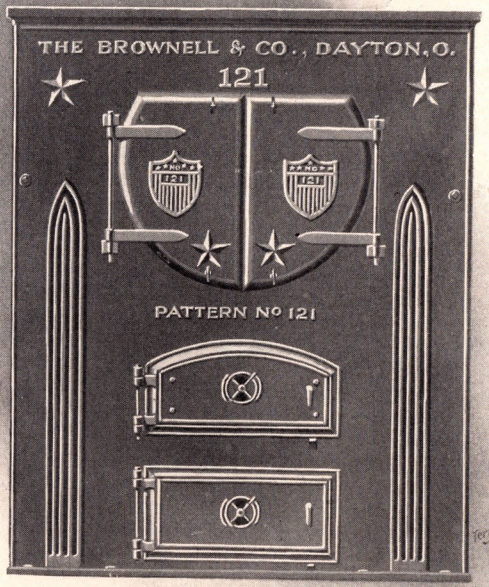


Fig. 16.

For Boilers 32 in. to 40 in. Inclusive.

Half Arch Front.

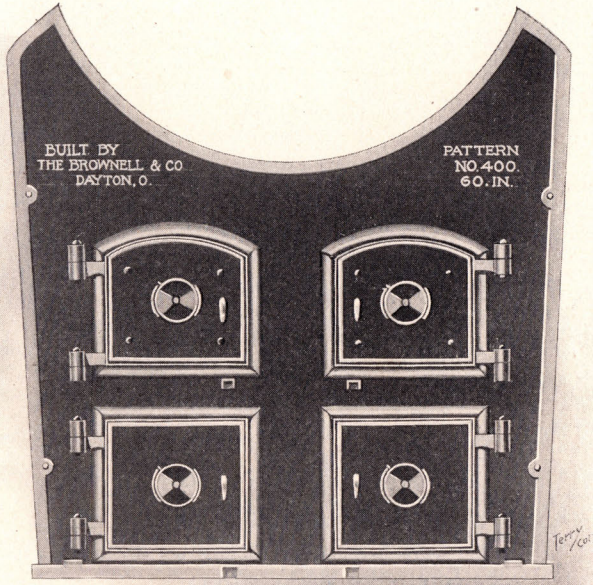


Fig. 17.

For Boilers 44 in. to 72 in. Inclusive.

Half Arch Front.

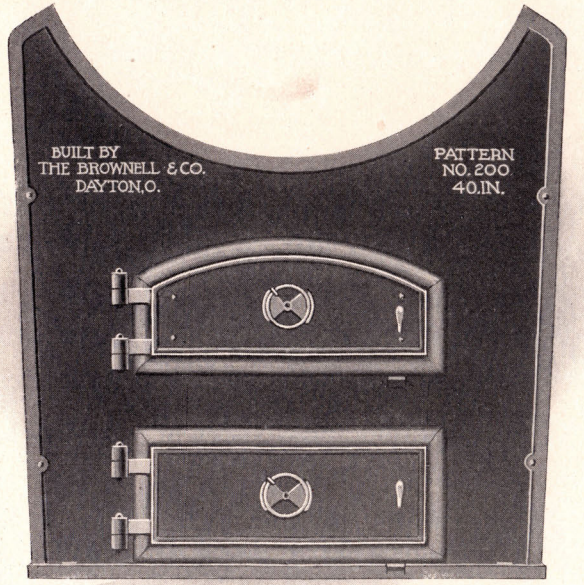


Fig. 18.

For Boilers 32 in. to 40 in. Inclusive.

Back View of Half-Arch Front.

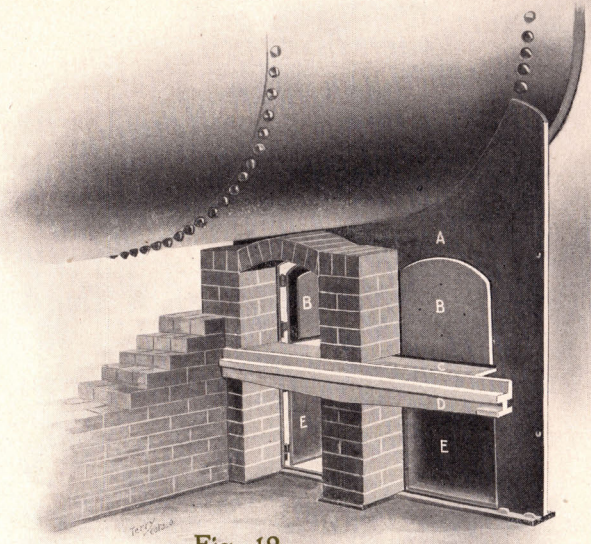


Fig. 19.

This cut shows front partly lined with brick, also position of front grate bar rest and coking plates.

A—Is front proper. BB—Are fire doors with linings shown. CC—Are Coking Plates. D—Is front Grate bar rest. EE—Are ash pit doors.

The other fixtures furnished with this front, namely: Grates, rear grate rest, soot door and frame, and flue plate, are shown in connection with flush front on page 31.

The Tupper Grates.

These Grate Bars are so well and favorably known, any enumeration of advantages is unnecessary; but their durability, adaptability, and applicability, covering the requirements of the first-class grate, have made them popular, and deservedly so. We furnish this style bar with all complete boilers unless otherwise specified.

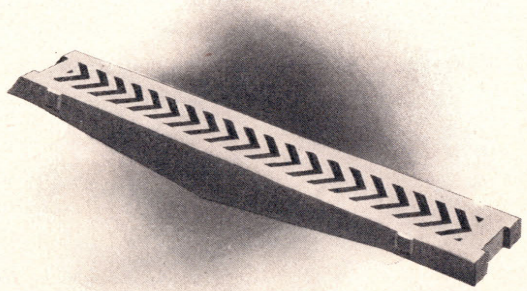


Fig. 20.

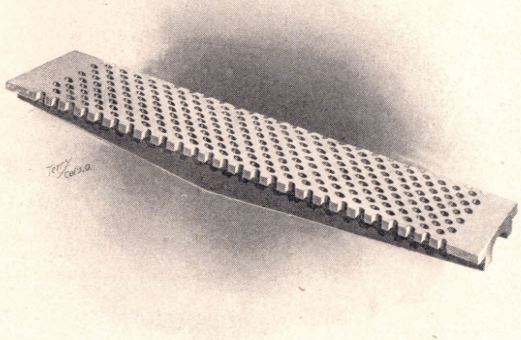


Fig. 21.

Our Saw-Dust Grate.

The many difficulties experienced with the earlier designs of grates for burning saw-dust, and the objections thereto, are overcome, we believe, in this grate, many tests indicating that the air admitted into the furnace is equally distributed over the ENTIRE GRATE surface, effecting UNIFORM temperature and combustion throughout.

We make and furnish Plain Grates when desired.

Smoke Connections.

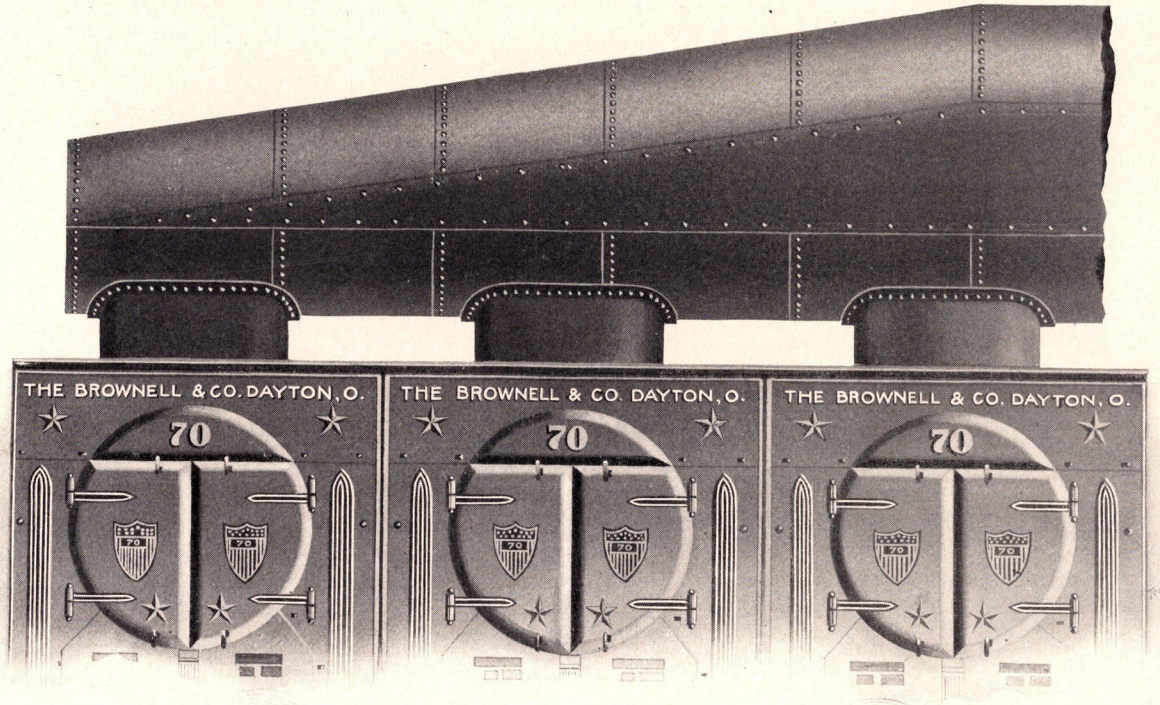


Fig. 22.

Smoke Connections.

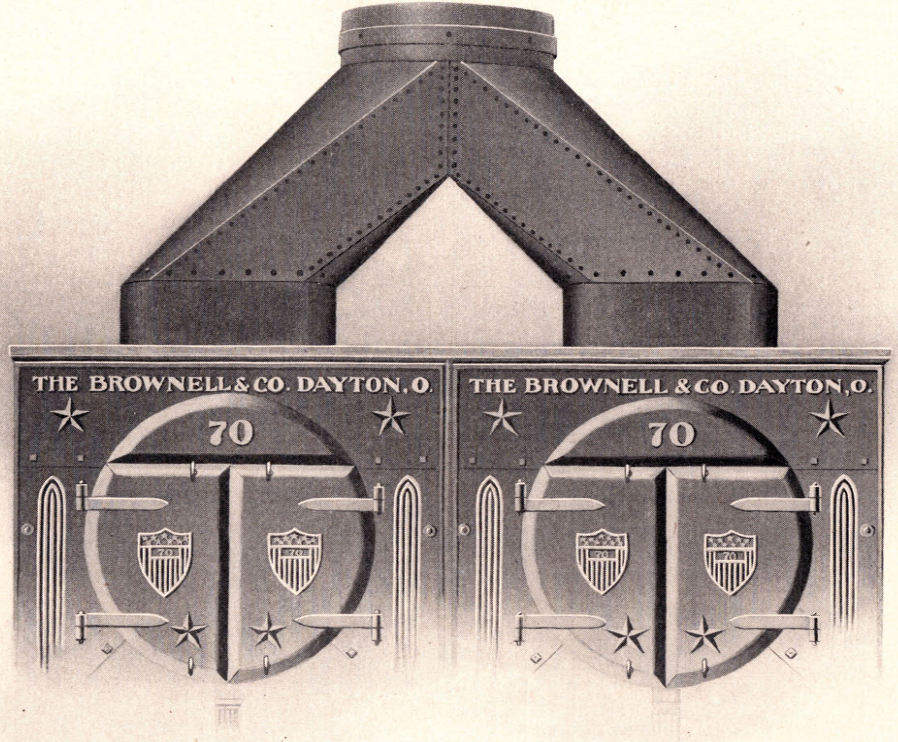


Fig. 23.

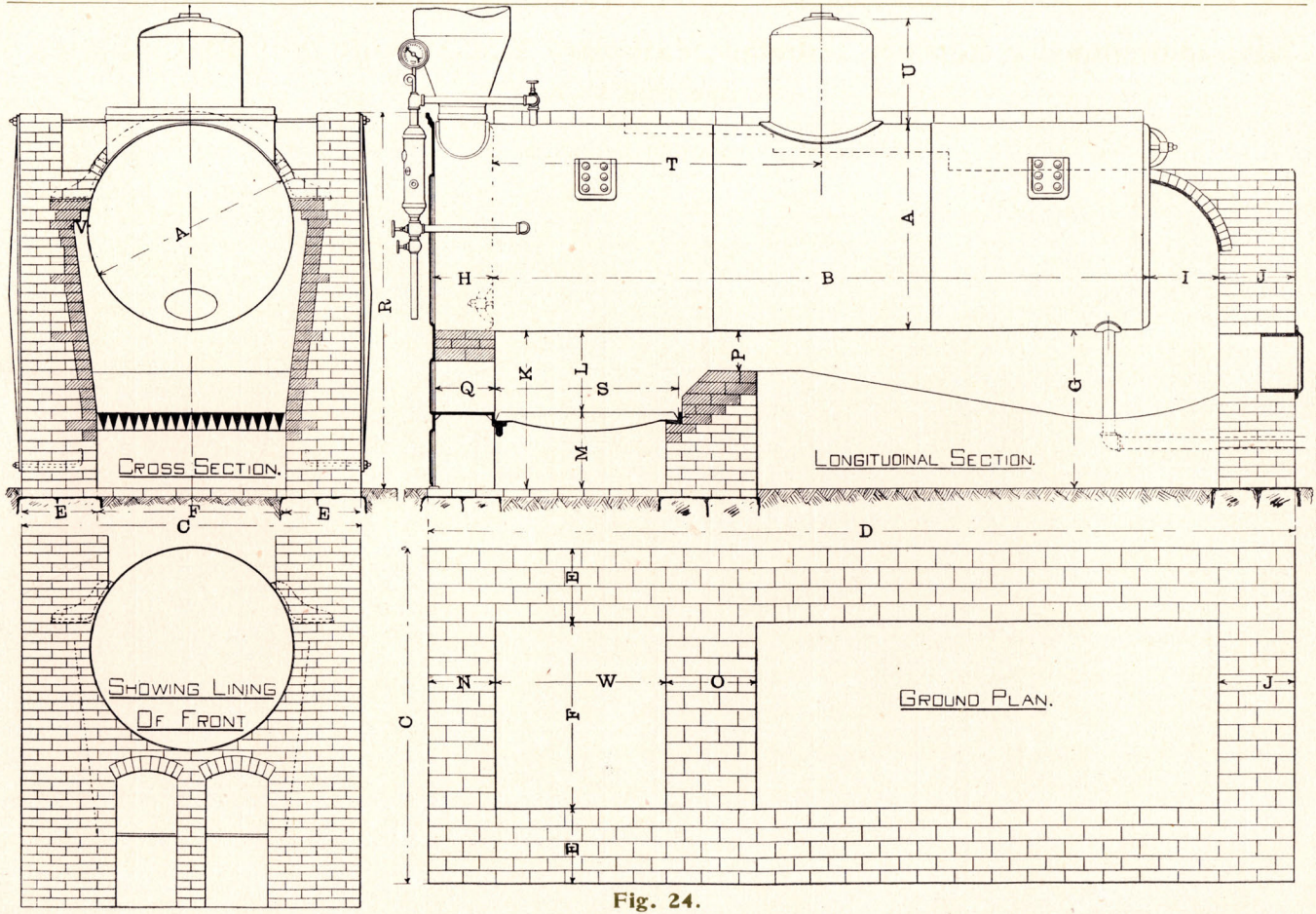
Smoke Connections are made in so many different forms that we illustrate the two in most general demand. We make anything that is wanted.

Measurements for Setting Tubular Stationary Boilers with Full-Flush Fronts.

Setting Plan No. 1.

No. of Front	REFERENCE LETTERS ON DIAGRAM.																						No. of Fire Brick	No. of Common Brick above floor level
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	
	Inch	Feet	Inch	Ft. In.	Inch	Inch	Inch	Inch	Inch	Inch	Inch	Inch	Inch	Inch	Inch	Inch	Inch	Inch	Inch	Inch	Inch	Inch	Inch	
	32	8	57	11-9	13	31	39½	12½	16	13	40½	20½	20	13	18	8	12	84	33	42	16	3	30	350	5,000
	36	8	57	11-9	13	31	39½	12½	16	13	40½	20½	20	13	18	8	12	84	33	42	18	3	30	350	5,000
120	36	10	57	13-9	13	31	39½	12½	16	13	40½	20½	20	13	18	8	12	84	36	40	18	3	33	400	5,000
	40	10	63	14 4	13	37	39½	14¾	18	13	40½	20½	20	17½	18	10	12	84	36	36	21	3	33	400	5,500
	40	12	63	16-4	13	37	39½	14¾	18	13	40½	20½	20	17½	18	10	12	84	42	48	21	3	39	450	7,000
95	44	12	78	16-8	17½	43	42	14¾	18	17½	43½	22	21½	17½	21	10	12	92	42	46	23	3	39	500	8,500
	44	14	78	18-8	17½	43	42	14¾	18	17½	43½	22	21½	17½	21	10	12	92	48	58	23	3	45	500	8,500
90	48	12	78	16-8	17½	43	42	14¾	18	17½	43½	22	21½	17½	24	10	12	96	48	46	24	3	45	500	10,000
	48	14	78	18-8	17½	43	42	14¾	18	17½	43½	22	21½	17½	24	10	12	96	54	58	24	3	51	550	11,000
70	54	14	93	19-3	22	49	46½	16½	20	22	48½	24	24½	20	24	12	15	108	48	56	28	4	45	650	12,500
	54	16	93	21-3	22	49	46½	16½	20	22	48½	24	24½	20	24	12	15	108	54	86	28	4	51	650	13,000
80	60	16	99	21-3	22	55	46½	16½	20	22	48½	24	24½	22	26	12	18	114	54	86	30	4	51	800	17,500
100	66	16	105	21-6	22	61	50½	17½	22	22	52½	28	24½	22	26	14	18	126	54	87	34	4	51	1,000	20,000
	66	18	105	23-6	22	61	50½	17½	22	22	52½	28	24½	22	26	14	18	126	60	98	34	4	57	1,000	21,000
140	72	16	120	21-9	26	67	53	19½	24	22	55	30	25	22	30	14	18	138	60	87	36	4	57	1,100	22,500
	72	18	120	23-9	26	67	53	19½	24	22	55	30	25	22	30	14	18	138	66	99	36	4	63	1,300	24,000

FULL FLUSH FRONT.



Setting Plan No. 1.

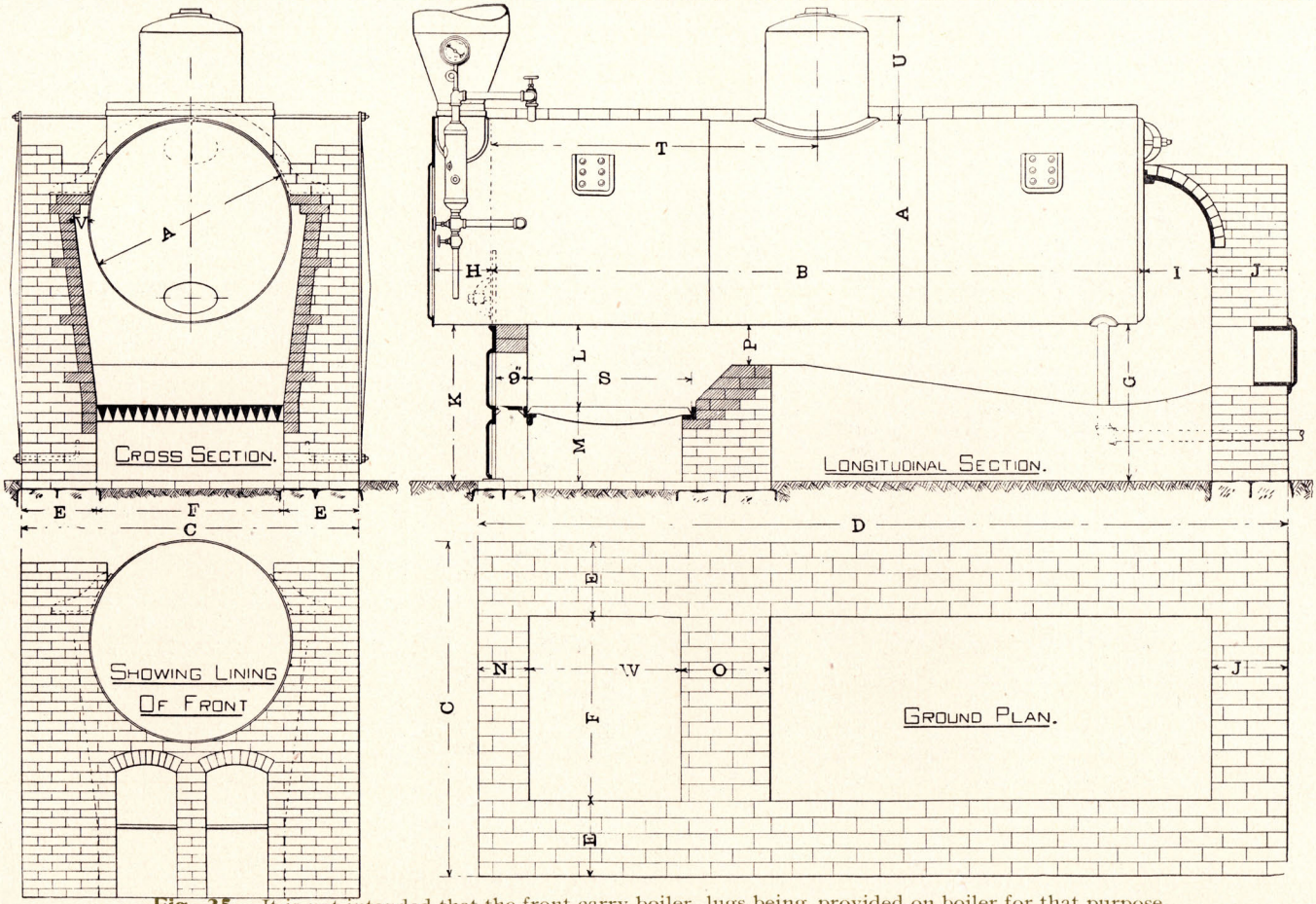
Fig. 24.

Measurements for Setting Tubular Stationary Boilers with Half Arch Fronts.

SETTING PLAN No. 2.

Number of Front.	REFERENCE LETTERS ON DIAGRAM																				Number of Fire Brick.	Number of Common Brick above Floor Level.
	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	S	T	U	V	W	
	Inch	Feet	Inch	Ft. In	Inch	Inch	Inch	Inch	Inch	Inch	Inch	Inch	Inch	Inch	Inch	Inch	Inch	Inch	Inch	Inch	Inch	
200	32	8	57	10-10	13	31	39	12½	16	13	40	20	20	14	18	8	33	42	16	3	30	325	3,500
	36	8	57	10-10	13	31	39	12½	16	13	40	20	20	14	18	8	33	42	18	3	30	350	3,600
	36	10	57	12-10	13	31	39	12½	16	13	40	20	20	14	18	8	36	40	18	3	33	350	4,000
	40	10	63	13-	13	37	39	14¾	18	13	40	20	20	14	18	10	36	36	21	3	33	400	6,000
	40	12	63	15-	13	37	38½	14¾	18	13	40	20	20	14	18	10	42	48	21	3	39	500	7,300
300	44	12	78	15-4	17½	43	45	14¾	18	17½	46½	24	22½	14	21	10	42	46	23	3	39	500	7,400
	44	14	78	17-4	17½	43	45	14¾	18	17½	46½	24	22½	14	21	10	48	58	23	3	45	525	8,300
	48	12	78	15-4	17½	43	45	14¾	18	17½	46½	24	22½	14	24	10	48	46	24	3	45	525	8,500
	48	14	78	17-4	17½	43	45	14¾	18	17½	46½	24	22½	14	24	10	54	58	24	3	51	550	9,300
400	54	14	93	18-	22	49	46½	16½	20	22	48½	24	24½	14	24	12	48	56	28	4	45	550	10,000
	54	16	93	20-	22	49	46½	16½	20	22	48½	24	24½	14	24	12	54	86	28	4	51	550	10,500
	60	16	99	20-	22	55	46½	16½	20	22	48½	24	24½	14	26	12	54	86	30	4	51	675	14,000
500	66	16	105	20-2	22	61	48½	17½	22	22	50½	26	24½	14	26	14	54	87	34	4	51	825	16,000
	66	18	105	22-2	22	61	48½	17½	22	22	50½	26	24½	14	26	14	60	98	34	4	57	825	17,000
	72	16	120	20-3	26	67	48½	19½	24	22	50½	26	24½	14	30	14	60	87	36	4	57	900	18,000
	72	18	120	22-3	26	67	48½	19½	24	22	50½	26	24½	14	30	14	66	99	36	4	63	1,000	20,000

HALF ARCH FRONT.



Setting Plan No. 2

Fig. 25. It is not intended that the front carry boiler, lugs being provided on boiler for that purpose.

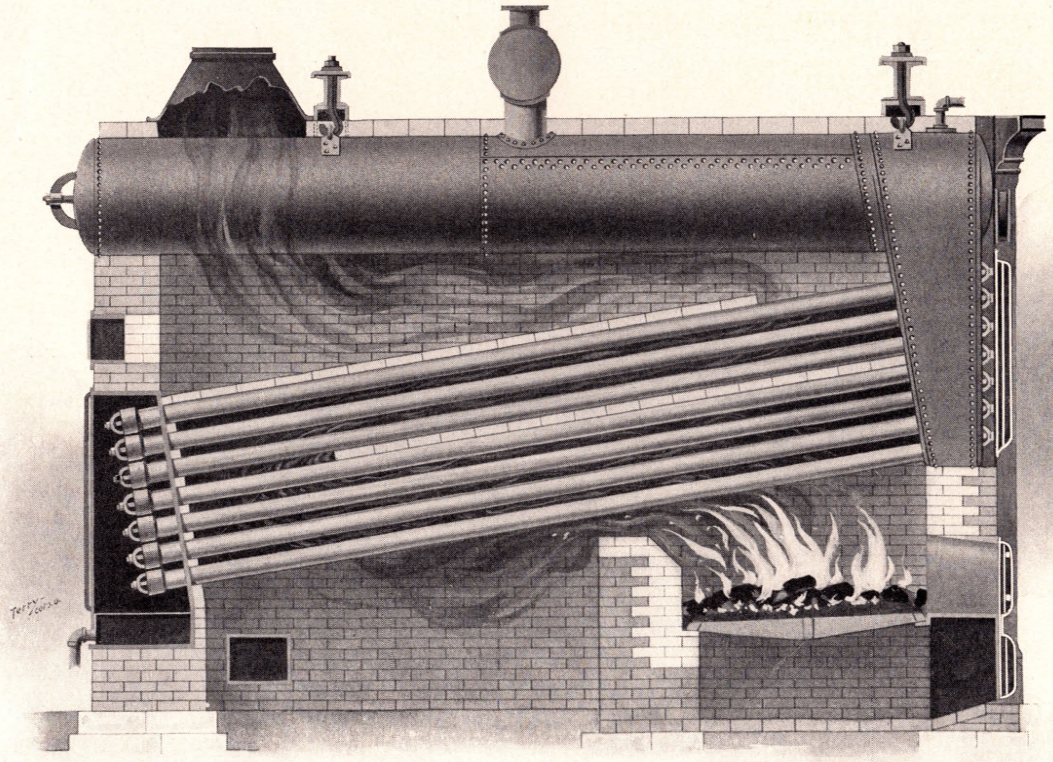


Fig. 26. THE "BROWNELL" PATENT SAFETY WATER-TUBE BOILER.

DURABLE
ECONOMICAL
SAFE.

This Boiler possesses more valuable features than any other boiler of its class on the market.

Built in Units of 50 Horse Power to 500 Horse Power.

If interested, write for information.

DRY STEAM.
NO SCALE.
EASY TO CLEAN.

STEAM BOILER INCRUSTATION AND ITS EFFECTS.

The evil effects of scale are due to the fact that it is relatively a non-conductor of heat. Its conducting power, compared with that of the iron (according to Despretz), is as 1 to 37.5 — about; accordingly, more fuel is required to heat water through the shell and flues of an incrusted boiler than would be required if the boiler were clear of scale. It is readily demonstrated that a scale one sixteenth of an inch thick will demand the extra expenditure of about 15 per cent. more fuel. This ratio increases as the scale grows thicker; thus, when it is one-quarter of an inch thick 60 per cent. more fuel is needed; when it is one-half an inch thick 150 per cent., and so on. The crust sometimes becomes so thick as to prevent a sufficient heating of the water by the burning of any amount of fuel that can be placed in the furnace. If a boiler be perfectly clean the contained water may be raised to any given temperature by heating the external fire surface to a temperature a few degrees higher; but if any scale be present, it will be necessary to heat it still higher. To illustrate: To raise steam to a pressure of 90 pounds, the water must be heated to 320 degrees Fahrenheit. If the boiler be clean, this may be done by heating the fire surface to about 325 degrees; but if one-half inch of scale intervenes between the shell and the water, such is its non-conduction that it will be necessary to raise the fire surface to a temperature of about 700 degrees — almost low red heat. Now, the higher the temperature at which iron is kept the more rapidly it oxydizes or carbonizes and undergoes molecular change. At any temperature above 600 degrees it soon loses the fibrous nature of the wrought iron and becomes granular like cast iron which it has really become, by carbonization. In this condition it is brittle, thin, and, under high heats, liable to bulge, or even give way to the great pressure upon it. Weakness of boilers thus produced predisposes them to explosions and causes necessarily expensive repairs. Another evil resulting from the presence of scale, is that it renders slower and more difficult the raising, maintaining, and lowering of steam.

On the following pages we illustrate three styles of exhaust steam feed water heaters, by the use of one of which the above mentioned evil effects can be largely obviated, and at the same time a saving will be effected by absorbing a large quantity of the heat in the exhaust steam and returning same to boiler, all of which would otherwise be lost. No steam plant, be it large or small, should be operated without an exhaust feed water heater.

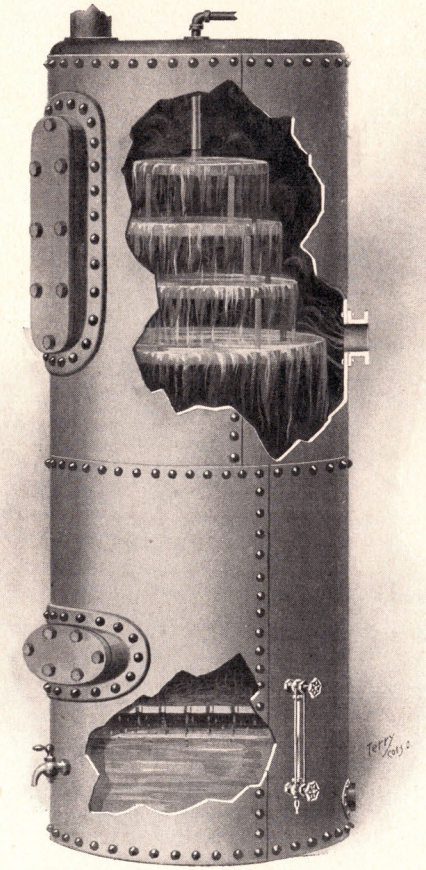


FIG. 27

Heater and Lime Extractor.

This Heater will, with exhaust steam, heat the water to about 200 degrees, at which temperature nearly all the lime and other impurities are precipitated, and, referring to the cut, we beg to say that now we are placing in our Heater a series of pans placed one above another, which, with the filtration chamber, increases the elimination of impurities in the feed water, precipitating and preventing them entering the Boiler. There is no Heater more easily cleaned, and we guarantee it to fill the requirements of a first-class Heater and Lime Extractor.

DESIGNED FOR ENGINES.	HEIGHT OF HEATER.	DIAMETER OF HEATER.
15 Horse Power.	48 inches.	18 inches.
25 Horse Power.	60 inches.	18 inches.
40 Horse Power.	72 inches.	24 inches.
60 Horse Power,	72 inches.	30 inches.
80 Horse Power.	84 inches.	30 inches.
100 Horse Power.	84 inches.	36 inches.
125 Horse Power.	96 inches.	38 inches.

Standard Feed Water Heaters

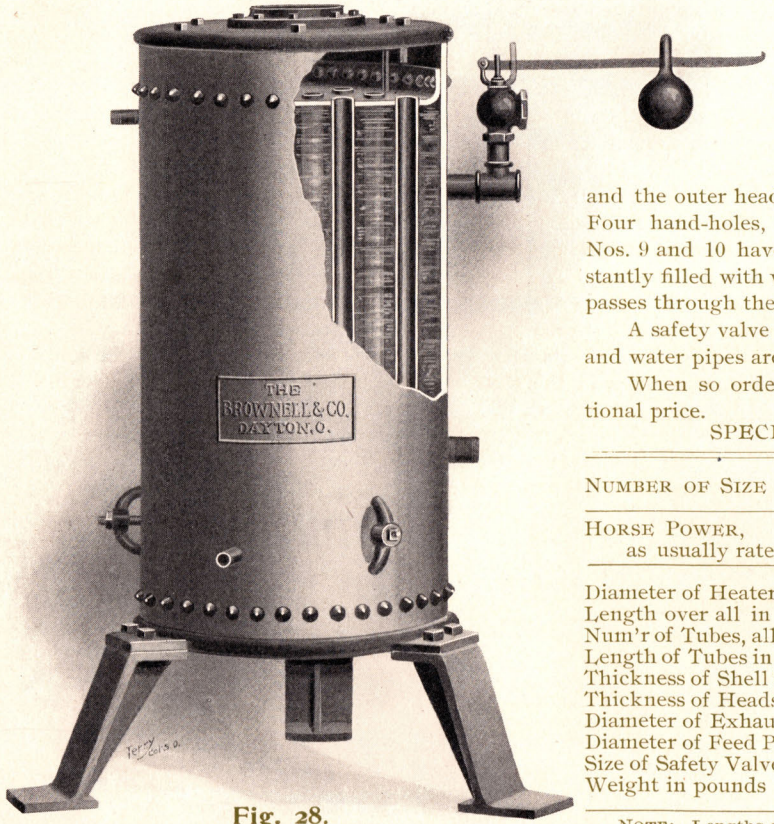


Fig. 28.

The "Standard" is a very popular form of Tubular Heater, simple in construction and efficient in operation. Its construction will be readily understood by referring to the engraving.

A steam chamber is provided at each end of the Heater. The inner heads are connected by two-inch tubes, and the outer heads are held in place by stud bolts, and are easily removed. Four hand-holes, conveniently placed, afford ready access for cleaning. Nos. 9 and 10 have six hand-holes. The body of the Heater is kept constantly filled with water surrounding the tubes, and exhaust from the engine passes through the tubes.

A safety valve is furnished with each Heater, but all connecting steam and water pipes are subject to order and charged extra.

When so ordered we make these Heaters with brass tubes at an additional price.

SPECIFICATIONS OF STANDARD HEATERS.

NUMBER OF SIZE	1	2	3	4	5	6	7	8	9	10
HORSE POWER, as usually rated.....	35	50	60	75	80	100	150	200	300	350
Diameter of Heater in ins...	20	20	20	24	24	30	30	36	42	42
Length over all in ins	42	42	48	48	52	58	68	78	84	84
Num'r of Tubes, all 2-in. dia.	15	20	20	27	32	46	52	66	80	100
Length of Tubes in ins.....	30	30	36	36	36	42	48	54	60	60
Thickness of Shell in ins...	7/32	7/32	7/32	7/32	7/32	1/4	1/4	1/4	9/32	9/32
Thickness of Heads in ins...	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8	3/8
Diameter of Exhaust in ins	3	3½	4	4½	4½	6	7	10	10	10
Diameter of Feed Pipe in ins.	½	¾	1	1¼	1¼	1½	2	2	2½	2½
Size of Safety Valve in ins...	1	1	1	1¼	1¼	1½	2	2	2½	2½
Weight in pounds ...	1000	1050	1100	1300	1400	1800	2000	2800	3400	3600

NOTE:—Lengths over all given above do **not** include legs.

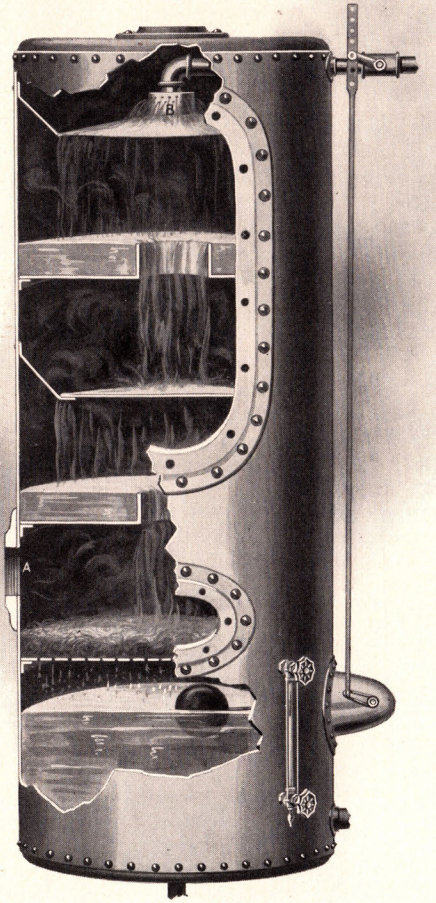


Fig. 29

Improved '94 Heater and Purifier.

As a result of long experience in the manufacture of heaters, and our determination to meet all the requirements of first-class steam plants, we have designed the Heater and Purifier shown herewith. While it possesses a number of improvements over our older patterns, it has lost none of their simplicity and ease of operation.

The exhaust enters the heater at "A" and passes upward through alternate internal and external openings and out at the top of Heater.

The water is admitted into the water-box "B" at the top, from which it flows over the circular plate and downward, through the same openings through which the steam passes upward. By this arrangement the water is "whipped" by the steam at each successive fall, and deposits a portion of its impurities on each plate and pan, which receive it as it falls to the lower levels. This repeated spraying of the water by the steam passing through it as it falls in a thin sheet, imparts to it a temperature of about 212 degrees by the time it reaches the filtering material. Through this material, which may be hay, excelsior, or something similar in its nature, the water slowly passes down to the settling chamber. The depth of water in this chamber is regulated by a float which operates a valve in the supply pipe, as shown in cut.

The entire internal arrangement may be taken out through the door, or cleaned while in position through the door and man-hole.

For our Improved '94 Heater and Purifier we claim EXCEPTIONAL ECONOMY, EASE OF ACCESS FOR CLEANING, AUTOMATIC REGULATION, AND NONLIABILITY TO GET OUT OF ORDER, and we guarantee it to fill the requirements of a first-class Heater and Purifier.

DESIGNED FOR ENGINES	DIAMETER	HEIGHT
10 to 20 H. P.	20 inches	6 feet, 6 inches
20 to 50 H. P.	24 inches	7 feet
50 to 100 H. P.	30 inches	8 feet
100 to 175 H. P.	36 inches	9 feet
200 to 350 H. P.	48 inches	10 feet
350 to 500 H. P.	48 inches	12 feet
500 to 1000 H. P.	66 inches	12 feet

Revised List of Proportions, Heating Surface, and Horse Power of Standard Horizontal Boilers.

We have revised our lists of Standard Boilers, and have brought their proportions into accordance with the most modern practice of the best builders. The calculations of heating surface in the following tables are based upon two-thirds of the shell and the whole of tubes.

BOILERS WITH TWO FLUES					BOILERS WITH 6-INCH FLUES					BOILERS WITH 4-INCH TUBES					BOILERS WITH 3½-IN. TUBES					BOILERS WITH 3-INCH TUBES				
SHELL		Diameter of Flue in Inches	Heating Surface Square Feet	Horse Power	SHELL		Number of Tubes	Heating Surface Square Feet	Horse Power	SHELL		Number of Tubes	Heating Surface Square Feet	Horse Power	SHELL		Number of Tubes	Heating Surface Square Feet	Horse Power	SHELL		Number of Tubes	Heating Surface Square Feet	Horse Power
Diam. in Inches	Length in Feet				Diam. in Inches	Length in Feet				Diam in Inches	Length in Feet				Diam. in Inches	Length in Feet				Diam. in Inches	Length in Feet			
30	10	10	100.	10.	40	14	7	252.	25.2	40	10	20	279 8	23.3	32	8	18	176.6	14.7	32	8	14	132.6	10.
32	12	10	130.	16.2		16		288.	28.8		12		335.8	30.0		10		220.8	18.4		10		165.8	12.3
	14		152.	19.0		18		324.	32.4		14		391.7	34 3	36	8	22	211.4	17.6	36	8	24	201.0	15.1
	16		173.	21.6	44	14	8	283.	28 3	44	12	24	394.6	35.		10		264 3	22.		10		251.2	20.
36	14	12	176.	22.0		16		324.	32.4		14		460.3	40.		12		317.2	26.4		12		301.4	23.
	16		201.	25.1		18		364.	36 4		16		526.1	45.	40	10	25	298.8	24.9	40	10	32	321.0	24.2
	18		227.	28.4		20		405.	40.5		18		591.8	51.4		12		358.6	29.9		12		385.2	29.2
	20		252.	31.5	48	16	10	386.	38.6	48	12	30	478.6	45.		14		418.3	34.8		14		449.4	34.
40	16	13	220.	27.5		18		434.	43.4		14		558.3	50.	44	12	28	400 0	35.0	44	12	42	487.9	36 1
	18		248	31.0		20		482.	48.2		16		638.1	57.1		14		466.6	40.0		14		569.1	42.2
	20		276.	34.		22		530.	53.0		18		717.8	64.2		16		533 3	45.7		16		650.4	48.2
	22		303.	37.8	50	18	12	497.	49.7	54	12	34	541.4	51.5	48	12	34	474.3	45.0	48	12	50	571.6	42.4
42	18	14	264.	33.0		20		552.	55.2		14		631.7	60.		14		533.3	50.		14		666.9	50.
	20		292.	36.5		22		607.	60.7		16		721.9	70.		16		632.4	57.		16		762 2	57.
	22		332.	40.2	54	18	12	509.	50.9		18		812.2	78.7		18		711.4	64.1		18		857.5	64.
	24		352.	44.0		20		566.	56.6	60	14	44	793.4	67.5	54	12	46	618.7	52.	54	12	66	734.8	55.
44	18	15	280.	35.0		22		622.	62.2		16		906.7	80.		14		721.8	60		14		857.3	63.
	20		311	38.8	58	18	15	607.	60.7		18		1020.1	86.8		16		824.9	70.1		16		979.8	72.4
	22		341.	42.6		20		674.	67.4		20		1133.4	96 5		18		928 0	78.7		18		1102.3	81.6
	24		373.	46 6		22		741.	74.1	66	14	56	984.5	87.5	60	14	56	864.7	70.1	60	14	80	1025.8	76.
48	18	18	321.	40.1	60	18	16	641.	64.1		16		1125.1	100		16		988.3	80.0		16		1172.3	86.3
	20		356.	44 5		20		712.	71.2		18		1265.7	110 0		18		1111.8	90.0		18		1318.9	97.3
	22		392.	49 0		22		784.	78.4		20		1406.4	122.2		20		1235.3	100.0		20		1465.4	108.0
	24		427.	53.0	66	18	20	773.	77.3	72	14	72	1234.4	103.2	66	14	72	1084.6	92.6	66	14	102	1282.3	95.0
	26		464.	58.0		20		859.	85.9		16		1410.7	125.		16		1239 5	103.8		16		1465 4	108.5
50	18	18	327.	40.0		22		945.	94.5		18		1587.1	150.		18		1394.5	110.		18		1648.6	122.0
	20		363.	45.4	72	18	26	961.	96.1		20		1763.4	166.		20		1549.4	122.2		20		1831.8	135.8
	22		399.	49 9		20		1067.	106.7						72	14	92	1355.8	113.3	72	14	132	1626.7	120.
	24		435.	54.3		22		1174.	117.4							16		1549.5	129.4		16		1859.0	130.3
	26		472.	59.0		24		1281.	128.1							18		1743.1	150 0		18		2091.4	140.6
	28		508.	63.5												20		1936.8	161.3		20		2323.8	151.0

The horse power of boilers is generally rated at much below what the boilers are capable of when furnishing steam to first-class engines. The number of square feet of heating surface allowed in these tables is ample to evaporate sufficient water for one horse power according to the Centennial Standard (30 pounds water evaporated per hour at 70 pounds steam pressure from feed water at 100° F); also for first-class automatic cut off engines. Where boilers are properly set and handled, the figures named, with economical engines, can be exceeded 25 per cent.

Heating Surface of Boilers.

The extent of the heating surface of a boiler depends on the length and diameter of the shell and the number and size of the tubes or flues.
When setting boilers in brick work the practice is to rack in the side walls to the shell a few inches below the water line, and thus limit the heating surface.
It is customary in calculating the heating surface of the shell to consider that two-thirds of it is exposed to the action of heat.
It is also customary to consider that the entire surface of the tubes or flues is exposed to the action of heat.
From the table given below, the heating surface of any boiler can be obtained with ease.

TABLE OF HEATING SURFACE.

Diameter of Boiler in inches	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	72
Two-thirds Heating Surface of Shell per foot of Length	4.19	4.54	4.89	5.24	5.59	5.93	6.28	6.63	6.98	7.33	7.68	8.03	8.38	8.73	9.08	9.42	9.77	10.12	10.47	10.82	11.17	11.52	11.87	12.22	12.57
Diameter of Tube or Flue in inches	2	2¼	2½	2¾	3	3¼	3½	3¾	4	4½	5	6	7	8	9	10	11	12	13	14	15	16	17	18	20
Whole External Heating Surface per foot of Length	.524	.589	.655	.720	.785	.850	.916	.982	1.05	1.18	1.31	1 57	1.83	2.09	2.36	2.62	2.88	3.14	3.40	3.66	3.93	4.19	4.45	4.71	5.24

Size of Tanks.

TABLE SHOWING THE NUMBER OF GALLONS IN CISTERNS AND TANKS.

Depth in Feet	DIAMETER IN FEET																	Depth in Feet
	5	6	7	8	9	10	11	12	13	14	15	16	18	20	22	24	25	
5	725	1,060	1,440	1 875	2,380	2,925	3,550	4,237	4,960	5,765	6,698	7,520	9 516	11,750	14,215	16,918	18,358	5
6	870	1,270	1,728	2,250	2,855	3,510	4,260	5,084	5.952	6,918	8,038	9,024	11,419	14,100	17,059	20,302	22 030	6
7	1,015	1,480	2,016	2,625	3,330	4,095	4,970	5,931	6,944	8,071	9,378	10,528	13,222	16.450	19,902	23,680	25 701	7
8	1,160	1,690	2,304	3,000	3,805	4,680	5,680	6,778	7,936	9,224	10,718	12,032	15.225	18,800	22,745	27,070	29,372	8
9	1,305	1,900	2,592	3.375	4,280	5,265	6,390	7,625	8,928	10,377	12,058	13 536	17,128	21,150	25,588	30,454	33,043	9
10	1,450	2,110	2 880	3,750	4,755	5,850	7,100	8,472	9,920	11,530	13,398	15,040	19,031	23 500	28,431	33,838	36,714	10
11	1,595	2,320	3,168	4,125	5.230	6,435	7,810	9,319	10,912	12.683	14,738	16,544	20,934	25,850	31,274	37,222	40,385	11
12	1,740	2,530	3,456	4,500	5,705	7,020	8,520	10,166	11,904	13,836	16,078	18,048	22,837	28,200	34,117	40,606	44,056	12
13	1,885	2,740	3,744	4,875	6,180	7,605	9,230	11,013	12,896	14,989	17,418	19,552	24,740	30,550	36.960	43,990	47,727	13
14	2,030	2,950	4.032	5.250	6,655	8 190	9,940	11,860	13,888	16,142	18,758	21,056	26,643	32,900	39,803	47,374	51,398	14
15	2,175	3,160	4,320	5.625	7,130	8,775	10,650	12,707	14,880	17,295	20,098	22,260	28.546	35,250	42,646	50,758	55.069	15
16	2 320	3.370	4,608	6,000	7,605	9,360	11.360	13,554	15 872	18,448	21,438	24,064	30,449	37.600	45,489	54,142	58,740	16
17	2.465	3.580	4.896	6,375	8.080	9,945	12,070	14.401	16 864	19,601	22,778	25.568	32,352	39,950	48 332	57,520	62,411	17
18	2,610	3,790	5,184	6,750	8,535	10,530	12.780	15,248	17,856	20,754	24.118	27,072	34,255	42,300	51,175	60,910	66,082	18
19	2,755	4,000	5,472	7,125	9,010	11,115	13,490	16,095	18,848	21,907	25,458	28,576	36,158	44,650	54.018	64,294	69,753	19
20	2,900	4,210	5,760	7,500	9,490	11,700	14,200	16,942	19,840	23,060	26,798	30,080	38,062	47,000	56,861	67,678	73,424	20

For tanks that are tapering, measure the diameter four-tenths from the large end.

SAFE WORKING PRESSURE.

Table showing the safe working pressure to use with cylindrical boilers using a factor of safety of six, adding twenty per cent. for double riveting.

Diameter of Boiler	Thickness of Shell	SINGLE RIVETED. Tensile Strength per Sq. Inch. Wrought Iron or Steel.			DOUBLE RIVETED SIDE SEAMS. Tensile Strength per Sq. Inch. Wrought Iron or Steel		
		50,000	55,000	60,000	50,000	55,000	60,000
Inches	Inches	Pressure	Pressure	Pressure	Pressure	Pressure	Pressure
40	3/16	78	86	94	94	103	113
	1/4	104	115	125	125	138	150
	5/16	130	143	156	156	172	187
42	3/16	74	82	89	89	98	107
	1/4	99	109	119	119	131	143
	5/16	124	136	149	149	163	179
44	3/16	71	78	85	85	94	102
	1/4	95	104	114	114	125	137
	5/16	118	130	142	142	156	170
46	3/16	68	75	82	82	90	98
	1/4	91	100	109	109	120	131
	5/16	113	125	136	136	150	163
48	3/16	65	72	78	78	86	94
	1/4	87	96	104	104	115	125
	5/16	109	120	130	130	144	156
50	1/4	83	92	100	100	110	120
	5/16	104	115	124	124	138	149
	3/8	125	138	150	150	166	180
54	1/4	77	85	92	92	102	112
	5/16	96	106	116	116	127	139
	3/8	116	127	139	139	152	167
60	1/4	70	77	83	83	92	100
	5/16	87	95	104	104	114	125
	3/8	104	115	125	125	138	150
66	1/4	63	69	76	76	83	91
	5/16	79	87	95	95	104	114
	3/8	95	104	114	114	125	137
72	1/4	58	64	69	69	77	83
	5/16	72	80	86	86	96	104
	3/8	87	96	104	104	115	125

PRESSURE, TEMPERATURE AND VOLUME OF STEAM.

Lbs. per Sq. Inch Atmosph. Pressure	Temperature	Volume	Lbs. per Sq. Inch	Temperature	Volume	Lbs. per Sq. Inch	Temperature	Volume	Lbs. per Sq. Inch	Temperature	Volume
*	212.8	1669	12	245.5	973	34	281.9	564	90	335 8	282
1	216.2	1573	14	249.6	911	40	289.3	508	95	339.2	271
2	219.6	1488	16	253 6	857	45	295.5	470	100	342.7	259
3	222 7	1411	18	267.3	810	50	301.3	437	105	345 8	251
4	225.6	1343	20	260.9	767	55	306.4	408	110	349.1	240
5	228.5	1281	22	264.3	729	60	311.2	383	115	352 1	233
6	231.2	1225	24	267.5	695	65	315.8	362	120	355.	224
7	233 8	1174	26	270.6	664	70	320.1	342	125	357 9	218
8	236 3	1127	28	273.6	635	75	324 3	325	130	360.6	210
9	238.7	1084	30	276.4	610	80	328.2	310	135	363.4	205
10	241	1044	32	279 2	586	85	332.	295	140	366	198

*These are boiler pressures (above atmospheric), as shown by the steam gauge. The temperatures are Fahrenheit scale. The Volumes given represent cubic inches of steam for every cubic inch of water evaporated.

CHIMNEYS.

The following table, calculated from approved formulæ by Wm. Kent, M. E., will be found useful in making approximate estimates. It is based on the supposition that a commercial horse power requires—as an average—the consumption of five pounds of coal per hour.

SIZES OF CHIMNEYS, WITH APPROXIMATE HORSE POWER OF BOILERS.

Diameter in Inches	HEIGHT OF CHIMNEYS AND COMMERCIAL HORSE POWER											Side of Square. Inches	Effectiv'e area. Sq. Feet	Actual area. Sq. Feet
	50 ft.	60	70	80	90	100	110	125	150	175	200			
18	23	25	27									16	9.97	1.77
21	35	38	41									19	1.47	2.41
24	49	54	58	62								22	2.08	3.14
27	65	72	78	83								24	2.78	3.98
30	84	92	100	107	113							27	3.58	4.91
33		115	125	133	141							30	4 48	5.94
36		141	152	163	173	182						32	5.47	7.07
39			183	196	208	219						35	6.57	8.30
42			216	231	245	258	271					38	7.76	9.62
48				311	330	348	365	389				43	10 44	12 57
54					427	449	472	503	551			48	13.51	15 90
60					536	565	593	632	692	748		54	16 98	19 64
66						694	728	776	849	918	981	59	20.83	23.76
72						835	876	934	1023	1105	1181	64	25.08	28.27
78							1038	1107	1212	1310	1400	70	29.73	33 18
84							1214	1294	1418	1531	1637	75	34.76	38.48
90								1599	1639	1770	1893	80	40.19	44.18
96									1876	2027	2167	86	46.01	50.27

Circumference and Area of Circles.

Diameter	Circumference	Area	Diameter	Circumference	Area	Diameter	Circumference	Area	Diameter	Circumference	Area
⅛	.3926	.0123	10	31.41	78.54	30	94.24	706.86	65	204.2	3318.3
¼	.7854	.0491	½	32.98	86.59	31	97.38	754.76	66	207.3	3424.2
⅜	1.178	.1104	11	34.55	95.03	32	100.5	804.24	67	210.4	3525 6
½	1.570	.1963	½	36.12	103.86	33	103.6	855.30	68	213.6	3631 6
⅝	1.963	.3067	12	37.69	113.09	34	106.8	907.92	69	216.7	3739.2
¾	2.356	.4417	½	39.27	122.71	35	109.9	962.11	70	219.9	3838.4
⅞	2.748	.6013	13	40.84	132.73	36	113.0	1017.8	71	223.0	3959.2
1	3.141	.7854	½	42.41	143.13	37	116.2	1075.2	72	226 1	4071.5
⅛	3.534	.9940	14	43.98	153.93	38	119.3	1134.1	73	229.3	4185.3
¼	3.927	1.227	½	45.55	165.13	39	122.5	1194.5	74	232.4	4300.8
⅜	4.319	1.484	15	47.12	176.71	40	125.6	1256.6	75	235.6	4417 8
½	4.712	1.767	½	48.69	188,69	41	128.8	1320.2	76	238.7	4536.4
⅝	5.105	2.073	16	50.26	201,06	42	131.9	1385.4	77	241.9	4656 0
¾	5.497	2.405	½	51.83	213.82	43	135.0	1452.2	78	245.0	4778.3
⅞	5.890	2.761	17	53.40	226.98	44	138.2	1520.5	79	248.1	4901,6
2	6.283	3.141	½	54.97	240,52	45	141.3	1590.4	80	251.3	5026.5
¼	7.068	3.976	18	56.54	254,46	46	144.5	1661.9	81	254.4	5153.0
½	7.854	4.908	½	58.11	268.80	47	147.6	1734.9	82	257.6	5281.0
¾	8.639	5.939	19	59.69	283,52	48	150.7	1809.5	83	60.7	5410 6
3	9.424	7.068	½	61.26	298.64	49	153.9	1885.7	84	263 8	5541.7
¼	10.21	8.295	20	62.83	314.16	50	157.0	1963.5	85	267 0	5674,5
½	10.99	9.621	½	64.40	330.06	51	160.2	2042.8	86	270.1	5808.8
¾	11.78	11.044	21	65.97	346.36	52	163.3	2123.7	87	273.3	5944 6
4	12.56	12.566	½	67.54	363.05	53	166.5	2206.1	88	276.4	6082.1
½	14.13	15.904	22	69.11	389.13	54	169.6	2290.2	89	279.6	6221 1
5	15.70	19.635	½	70.68	397.60	55	172.7	2375.8	90	282.7	6361.7
½	17.27	23.758	23	72.25	415.47	56	175.9	2463.0	91	285.8	6503.8
6	18.84	28,274	½	73.82	433.73	57	179.0	2551.7	92	289.0	6647.6
½	20.42	33.183	24	75.39	452.39	58	182.2	2642.0	93	292.1	6792.9
7	21.99	38.484	½	76.96	471.43	59	185.3	2733.9	94	295 3	6939.7
½	23.56	44.178	25	78.54	490.87	60	188.4	2827.4	95	298.4	7088.2
8	25.13	50,265	26	81.68	530.93	61	191.6	2922.4	96	301.5	7238 2
½	26.70	56.745	27	84.82	572.55	62	194.7	3019.0	97	304.8	7389,8
9	28.27	63.617	28	87.96	615.75	63	197.9	3117.2	98	307.8	7542.9
½	29.84	70.882	29	91.10	660.52	64	201 0	3216.9	99	311.0	7697.7

WEIGHT OF CIRCULAR BOILER HEADS

Diameter in Inches	THICKNESS IN INCHES														
	1/8	3/16	1/4	5/16	3/8	7/16	1/2	9/16	5/8	11/16	3/4	13/16	7/8	15/16	1
16	7	11	14	18	22	25	29	.....	.....	.....	.....	.....	.....	.....	.....
17	8	12	16	20	24	28	33	.....	.....	.....	.....	.....	.....	.....	.....
18	9	14	18	23	27	32	36	.....	.....	.....	.....	.....	.....	.....	.....
19	10	15	20	25	30	36	42	.....	.....	.....	.....	.....	.....	.....	.....
20	11	17	23	28	34	39	45	.....	.....	.....	.....	.....	.....	.....	.....
21	12	19	25	31	37	43	50	.....	.....	.....	.....	.....	.....	.....	.....
22	14	20	27	34	41	48	55	.....	.....	.....	.....	.....	.....	.....	.....
23	15	22	30	37	45	52	60	.....	.....	.....	.....	.....	.....	.....	.....
24	16	24	32	41	49	57	65	.....	.....	.....	.....	.....	.....	.....	.....
25	18	26	35	44	53	62	70	.....	.....	.....	.....	.....	.....	.....	.....
26	19	29	38	47	57	67	76	.....	.....	.....	.....	.....	.....	.....	.....
27	21	31	41	51	62	72	82	.....	.....	.....	.....	.....	.....	.....	.....
28	22	33	44	55	66	77	88	.....	.....	.....	.....	.....	.....	.....	.....
29	24	36	47	59	71	83	95	.....	.....	.....	.....	.....	.....	.....	.....
30	25	38	51	63	76	89	101	.....	.....	.....	.....	.....	.....	.....	.....
31	27	41	54	68	81	95	108	.....	.....	.....	.....	.....	.....	.....	.....
32	29	43	58	72	86	101	115	.....	.....	.....	.....	.....	.....	.....	.....
33	31	46	61	76	92	108	122	.....	.....	.....	.....	.....	.....	.....	.....
34	33	49	65	81	98	114	130	.....	.....	.....	.....	.....	.....	.....	.....
35	35	52	69	86	103	121	138	.....	.....	.....	.....	.....	.....	.....	.....
36	37	55	73	91	109	128	146	162	178	194	210	.....	.....	.....	.....
37	39	58	77	96	116	136	154	172	190	207	225	.....	.....	.....	.....
38	41	61	81	102	123	142	163	182	201	220	239	.....	.....	.....	.....
39	43	64	86	107	128	150	171	193	213	233	254	.....	.....	.....	.....
40	45	68	90	113	135	158	180	203	225	247	269	.....	.....	.....	.....
41	47	71	95	118	142	166	189	213	237	259	283	.....	.....	.....	.....
42	50	75	99	124	149	174	199	223	248	272	297	.....	.....	.....	.....
43	52	78	104	130	156	182	208	234	260	286	313	.....	.....	.....	.....
44	55	82	109	136	164	191	218	245	273	301	329	.....	.....	.....	.....
45	57	86	114	143	171	200	228	257	285	315	344	.....	.....	.....	.....
46	60	89	119	149	179	209	239	268	299	328	358	.....	.....	.....	.....
47	62	93	124	156	187	218	249	280	311	342	374	.....	.....	.....	.....
48	65	97	130	162	195	227	259	292	324	357	390	.....	.....	.....	.....
49	68	101	135	169	203	237	270	304	338	372	406	.....	.....	.....	.....
50	.....	106	141	176	211	246	281	317	352	387	422	.....	.....	.....	.....
51	.....	110	147	183	220	256	293	330	366	403	439	.....	.....	.....	.....
52	.....	114	152	190	228	266	304	343	381	419	457	.....	.....	.....	.....
53	.....	119	158	198	237	277	316	356	395	435	474	.....	.....	.....	.....
54	.....	123	164	205	246	287	328	369	410	451	492	.....	.....	.....	.....
55	.....	128	170	213	255	298	341	383	426	468	511	.....	.....	.....	.....
56	.....	132	177	221	265	309	353	397	441	485	530	.....	.....	.....	.....
57	.....	137	183	229	274	320	366	412	457	503	549	.....	.....	.....	.....
58	.....	142	189	237	284	331	379	426	473	521	568	.....	.....	.....	.....
59	.....	147	196	245	294	343	392	441	490	539	588	.....	.....	.....	.....
60	.....	.....	204	254	305	356	408	457	510	561	612	.....	.....	.....	.....
61	.....	.....	212	264	317	370	423	476	529	582	635	.....	.....	.....	.....
62	.....	.....	219	273	328	382	437	492	546	601	656	.....	.....	.....	.....
63	.....	.....	226	282	338	395	451	508	564	620	677	.....	.....	.....	.....
64	.....	.....	233	291	349	407	466	524	582	640	699	.....	.....	.....	.....
65	.....	.....	240	300	360	420	480	540	600	661	721	.....	.....	.....	.....
66	.....	.....	248	310	371	433	495	557	619	681	743	.....	.....	.....	.....
67	.....	.....	255	319	383	447	510	574	638	702	766	.....	.....	.....	.....
68	.....	.....	263	329	394	460	526	591	657	723	789	.....	.....	.....	.....
69	.....	.....	271	338	406	474	541	609	677	744	812	.....	.....	.....	.....
70	.....	.....	279	348	418	487	557	627	696	766	836	.....	.....	.....	.....
71	.....	.....	287	358	430	502	573	645	717	788	860	.....	.....	.....	.....
72	.....	.....	295	368	442	516	589	663	737	810	884	.....	.....	.....	.....
73	.....	.....	303	379	454	530	606	682	757	833	909	.....	.....	.....	.....
74	.....	.....	311	389	467	545	623	700	778	856	934	.....	.....	.....	.....
75	.....	.....	320	400	480	560	640	719	799	879	959	.....	.....	.....	.....
76	.....	.....	328	410	492	575	657	739	821	903	985	1067	1149	1231	1313
77	.....	.....	337	421	506	590	674	758	843	927	1011	1095	1180	1234	1348
78	.....	.....	346	432	519	605	692	778	865	951	1038	1124	1210	1297	1383
79	.....	.....	355	443	532	621	710	798	887	976	1064	1153	1242	1330	1419
80	.....	.....	367	458	550	641	733	830	917	1008	1100	1192	1283	1384	1476
81	.....	.....	378	473	568	662	757	851	946	1041	1135	1230	1324	1419	1514
82	.....	.....	388	485	582	679	776	872	969	1066	1163	1260	1357	1454	1551
83	.....	.....	397	497	596	695	795	894	993	1093	1192	1291	1390	1490	1589
84	.....	.....	407	509	610	712	814	916	1017	1119	1221	1322	1424	1526	1628
85	.....	.....	417	521	625	729	833	937	1042	1146	1250	1354	1458	1562	1667
86	.....	.....	427	533	640	746	853	960	1066	1173	1280	1386	1493	1599	1706
87	.....	.....	437	546	655	764	873	982	1091	1200	1309	1419	1528	1637	1746
88	.....	.....	447	558	670	782	893	1005	1117	1228	1340	1452	1563	1675	1787
89	.....	.....	457	571	685	779	914	1028	1142	1256	1370	1485	1599	1712	1827
90	.....	.....	467	584	701	817	934	1051	1168	1285	1401	1518	1635	1752	1869
91	.....	.....	.....	597	716	836	955	1075	1194	1313	1433	1552	1671	1791	1910
92	.....	.....	.....	610	732	854	976	1098	1220	1342	1463	1586	1708	1830	1953
93	.....	.....	.....	623	748	873	998	1122	1247	1372	1496	1621	1746	1870	1995
94	.....	.....	.....	637	764	892	1019	1146	1274	1401	1529	1656	1783	1911	2038
95	.....	.....	.....	651	781	911	1041	1171	1301	1431	1561	1692	1822	1952	2082
96	.....	.....	.....	664	797	930	1063	1196	1329	1462	1594	1727	1860	1993	2126
97	.....	.....	.....	678	814	950	1085	1221	1357	1492	1628	1764	1899	2035	2171
98	.....	.....	.....	692	831	969	1108	1246	1384	1523	1662	1800	1939	2077	2215
99	.....	.....	.....	707	848	989	1130	1272	1413	1554	1696	1837	1978	2120	2261
100	.....	.....	.....	721	865	1009	1153	1297	1442	1585	1730	1874	2018	2163	2307
101	.....	.....	.....	735	882	1029	1175	1322	1470	1616	1764	1910	2058	2205	2352
102	.....	.....	.....	750	899	1048	1197	1347	1498	1647	1798	1947	2098	2248	2398
103	.....	.....	.....	764	916	1068	1219	1372	1525	1678	1832	1984	2138	2291	2444
104	.....	.....	.....	779	933	1087	1241	1395	1551	1706	1862	2023	2178	2333	2488
105	.....	.....	.....	794	950	1107	1263	1420	1577	1735	1894	2056	2215	2374	2533
106	.....	.....	.....	808	967	1127	1286	1445	1605	1765	1926	2090	2254	2416	2578
107	.....	.....	.....	822	984	1147	1309	1470	1632	1796	1960	2126	2293	2459	2624
108	.....	.....	.....	836	1001	1166	1331	1496	1660	1827	1994	2162	2331	2499	2666
109	.....	.....	.....	850	1018	1186	1354	1522	1689	1858	2027	2197	2369	2539	2710
110	.....	.....	.....	865	1035	1205	1376	1547	1717	1888	2060	2232	2405	2580	2753
111	.....	.....	.....	879	1052	1225	1398	1572	1745	1919	2094	2268	2443	2620	2795
112	.....	.....	.....	894	1069	1245	1420	1596	1773	1950	2128	2306	2484	2663	2842
113	.....	.....	.....	909	1086	1264	1442	1620	1800	1980	2162	2341	2522	2704	2886
114	.....	.....	.....	923	1103	1284	1464	1645	1827	2010	2194	2377	2560	2745	2930
115	.....	.....	.....	938	1120	1303	1486	1670	1855	2040	2226	2412	2598	2785	2972

Heads below heavy line will run heavier than the weight given.

Rules for Firemen on the Care and Management of Steam Boilers.

1. **Height of Water.**—Inspect carefully the amount of water in boiler. Don't rely upon Water Gauge, as it becomes stopped up; but try Gauge Cocks and see that there is at least two and one-half inches of water over flues or crown sheets. Don't unbank fire or renew fuel until you are satisfied with the amount of water in boiler.

2. When water is found below Gauge Cocks, DON'T turn on the feed, and don't tamper with the Safety Valve nor open it. Let the Feed, Safety Valve, and steam outlets remain as they are. Cover the fire over with ashes or fresh coal (slack, if handy), or in case of firing with wood **withdraw** the fire and swing open the fire doors.

3. **In Case of Foaming**—Close throttle, and keep closed long enough to show true level of water. If that level is sufficiently high, feeding and blowing will usually suffice to correct the evil. In cases of violent foaming, caused by dirty water or change from salt to fresh, or vice versa, in addition to the action above stated, check draft and cover fires with fresh coal.

4. **Safety Valve.**—Never put any additional weights on Safety Valve Lever. See that it corresponds in blowing off with pressure indicated by Steam Gauge. Inspect frequently by raising the lever cautiously, as the valves may become stuck to seats and useless for the purpose intended.

5. **Feeding**—Never feed the boiler with cold water, but use some good form of heater. Not only is considerable fuel saved by this but repairs to boiler also. Never feed in the front end of a boiler (unless the pipe is carried well through to the rear end). If fed through the front end lime and other impurities are precipitated on the sheets over the fire, making them liable to bulge, sag, leak, and crack.

6. **Leaks and Blisters** — As soon as found they should be properly repaired.

7. **Blowing Off** — Blow off at least once in two weeks — every Saturday night would be better. In case the feed water is muddy, blow down a few inches **every day. Boilers should never be blown out while hot.** as the walls, plates, flues, and braces retain sufficient heat to bake the deposits of mud into a hard scale that becomes firmly attached to their surface, and with the outer walls and bridge walls hot there is danger of injury to the plates in the boiler. The boiler and walls should always be allowed to cool down before the water is run out; the deposit of mud and scale will then be quite soft, and can be easily washed out with a hose from all accessible places. Many engineers suppose that blowing out a boiler under pressure has a tendency to remove these deposits from a boiler, but experience has shown this to be a very grave mistake.

8. **Removing Deposit and Sediment** — In tubular boilers the man hole should be often opened, and all collections removed from over the fire. (For extracting lime and other impurities, see our Heaters, pages 44, 45 and 46.)

9. **Mud Drums** — Inspect carefully and as often as you do the boiler. Remove man-head and clean out. Mud Drums are frequently the source of accidents, as they are liable to give out before the boiler does, and are often placed in inaccessible places where they are overlooked.

10. **Firing** — In firing with coal, keep your grates covered with a thin fire. Fire often and not too much at a time. If too fast in steaming, close dampers and shut off draft.

11. **Cleanliness** — It is important that the sheets of boiler and all fittings, particularly the Feed, be kept clean and free. Tubes, Flues, Smoke Connection, and Boiler Room should be well swept.

USEFUL INFORMATION.

To find circumference of a circle multiply diameter by 3.1416.

To find diameter of a circle multiply circumference by .31831.

To find area of a circle multiply square of diameter by .7854.

To find surface of a ball multiply square of diameter by 3.1416.

To find side of an equal square multiply diameter by .8862

To find cubic inches in a ball multiply cube of diameter by .5236.

Doubling the diameter of a pipe increases its capacity four times.

A gallon of water (U. S. standard) weighs 8⅓ lbs. and contains 231 cubic inches.

A cubic foot of water contains 7½ gallons, 1728 cubic inches, and weighs 62½ lbs.

To find the pressure in pounds per square inch of a column of water multiply the height of the column in feet by .434.

Steam rising from water at its boiling point (212 degrees) has a pressure equal to the atmosphere (14.7 lbs. to the square inch).

A standard horse power: The evaporation of 30 lbs. of water per hour from a feed water temperature of 100 degrees F. into steam at 70 lbs. gauge pressure. (Equivalent to 34½ lbs. from and at 212 degrees Fahr.)

To find capacity of tanks any size; given dimensions of a cylinder in inches, to find its capacity in U. S. gallons; square the diameter; multiply by the length and by .0034.

To ascertain heating surface in tubular boilers multiply two-thirds the circumference of boiler by length of boiler in inches and add to it the outside surface of all the tubes.

One-sixth of tensile strength of plate multiplied by thickness of plate and divided by one-half the diameter of boiler gives safe working pressure for tubular boilers with single riveted longitudinal seams. Add 20% for double riveted seams.

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